

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LIFTWERX USA INC.,
Petitioner

v.

LIFTRA IP APS,
Patent Owner.

Case: IPR2026-00102
Patent No. 12,104,578

DECLARATION OF JOHN BOSCHE IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW

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I. INTRODUCTION

1. I have been retained by LiftWerx USA Inc. (“Petitioner”) to provide my opinions concerning the validity of claims 1-17 (the “Challenged Claims”) of U.S. Patent No. 12,104,578 (the “’578 Patent” or the “Challenged Patent”) (Ex. 1001).

2. This Declaration summarizes the opinions I have formed to date. I reserve the right to modify my opinions, if necessary, based on further review and analysis of information that I receive subsequent to the filing of this declaration, including in response to evidence presented or positions taken by Liftra IP ApS (“Liftra” or “Patent Owner”) or its experts that I have not yet seen, including any evidence of secondary considerations that Liftra or its experts may consider and present.

3. It is my opinion that the Challenged Claims are invalid based on the following grounds:

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Ground	Claims	Basis	References
1	1-4, 6-8, 10, and 13-14	§103	Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann
2	2, 5, and 15	§103	Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann further in view of Hanxing and/or Schulz
3	9, 11-12, and 16-17	§103	Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann further in view of Cooper, Schaeffler, and/or Guerenbourg
4	1, 3-17	§102	'518 Patent

**II. EXPERIENCE, QUALIFICATIONS, AND STATUS AS AN
INDEPENDENT EXPERT WITNESS**

4. My curriculum vitae, with a more detailed summary of my background, experience, publications that I have authored in the past ten years, and qualifications, is provided as Exhibit 1004.

5. I obtained a Bachelor's of Science degree in Mechanical Engineering from West Virginia University in 1989 and a Master's of Science degree in Mechanical Engineering from the University of Texas at El Paso in 1995. My Master's degree was specifically focused on wind energy and wind turbine design

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and my Master's thesis was on the topic of Control Strategies for Variable Speed
Wind Turbines.

6. My first professional experience began in 1989 as a Patent Examiner at the US Patent & Trademark Office. I took the Patent Agent bar exam upon leaving employment, and I have been a Patent Agent ever since then. I am preparing this declaration, however, as a technical expert, and am not holding myself out as an expert in patent law.

7. I began working in the wind industry in 1991 with a position as Project Engineer at the Wind Harvest Company. My role was to build and test prototypes of their innovative vertical axis Windstar wind turbine. I also spent time in Wales in the United Kingdom with Wind Harvest Company, establishing a wind turbine manufacturing facility and installing the first five wind turbines built in that facility.

8. During 1994 and 1995, I was a graduate student at University of Texas at El Paso where I worked as a graduate research assistant modifying and testing the university's test wind turbine. My job was to convert the wind turbine from constant speed operation to variable speed operation using both a power electronic converter and a mechanical continuously variable transmission system.

9. From 1996 to 1998, I worked for Dynamic Design testing wind turbines in Palm Springs and Tehachapi, California. At Dynamic Design, I was responsible for performing loads, vibration, and performance testing on several wind turbine

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models including the innovative 5-bladed PSE wind turbine and the 2-bladed Wind
Eagle wind turbine. I also performed testing on more conventional wind turbines
from Mitsubishi Heavy Industries, Vestas, Nordtank, and Nedwind.

10. From 1998 to 2001 I worked at a consulting firm in Seattle called
Global Energy Concepts (GEC) as a Senior Project Engineer. GEC was
subsequently purchased by DNV and is now the US office of international consulting
firm DNV-GL. During my time at GEC, I worked on a program called the Turbine
Verification Program in which we worked under funding from the US Department
of Energy and the Electric Power Research Institute to support several electric
utilities as they developed, built, and operated their first demonstration wind farms.
The projects were in Texas, Vermont, Wisconsin, Iowa, Nebraska, and Alaska.
GEC's support included technical assistance for the utilities as they procured wind
turbines, obtained permits, financing, and other necessary permissions, during
construction of the wind farms, and during the first several years of operation of the
wind farms. During my time at GEC, I also worked on a project funded by the
National Renewable Energy Laboratory to research scaling effects and roadblocks
related to scaling wind turbines to significantly larger size than was commercially
available in the late 1990s. In particular, I led the research on a project that
investigated self-erecting wind turbines, including a crane that could crawl up the
wind turbine tower to install subsequent sections of the wind turbine.

11. In 2001, I founded Chinook Wind, a consulting firm providing technical assistance to developers and investors in the wind energy industry. My role at Chinook Wind was Principal Engineer. At Chinook Wind, I worked on all aspects of wind farm development, construction, and operation. One project I worked on was management of construction for the Mountain View III wind farm in Palm Springs, CA on behalf of PPM Energy (now Avangrid Renewables). I also provided Independent Engineering due diligence to banks investing in wind farms, helping them to identify and quantify investment risks. The Independent Engineering work frequently involved review of construction plans and maintenance plans, including plans for replacement of gearboxes and main bearings in wind turbines. Another project at Chinook Wind involved review of all insurance claims received by AIG on wind turbine component failures. That insurance claim review work frequently involved review of plans for up-tower or down-tower replacement or repair of major components in wind turbines from all manufacturers and review of repair costs including the costs of mobile cranes to help facilitate the repairs.

12. In 2017, Chinook Wind merged with another consulting firm, V-Bar, to form ArcVera Renewables where I was the President and Principal Engineer, and a 34% owner. ArcVera Renewables provided a full range of technical consulting services to wind farm developers, constructors, investors, owners, and operators, spanning the full project life cycle from site prospecting through construction and

then through the operations phase up to and including repowering or decommissioning. ArcVera Renewables expanded operations during my time as President and Principal Engineer from North America to a global footprint with subsidiary offices in Brazil, India, and South Africa and client projects on 6 continents.

13. In 2024, ArcVera Renewables was acquired by Bureau Veritas, a publicly traded consulting firm based in Paris, France. Bureau Veritas has approximately 86,000 employees and offices in 140 countries. My role at Bureau Veritas continues to be President and Principal Engineer. At Bureau Veritas, I am responsible for profit and loss of the renewable energy technical advisory business in North America. I am also responsible for ensuring quality control on all reports issued globally in the field of wind energy engineering.

14. I have been a thought leader in the wind energy industry for over 25 years, including authoring and co-authoring publications, giving presentations to industry groups, organizing and attending industry conferences, and participating in international standards committees.

15. Some of the presentations I have authored or co-authored include topics related to wind farm operations and maintenance including the following:

- **Wind Farm Operation and Maintenance Costs – Real Life Experiences and Summary of Projected Costs:** WindAC, Cape Town, South Africa, November 2017.

- **Wind Farm Operations and Maintenance:** RECAM, Panama City, Panama, March 2017
- **Wisconsin Low Wind Speed Turbine Project Third-Year Operating Experience: 2000-2001**, U.S. Department of Energy - Electric Power Research Institute Wind Turbine Verification Program, EPRI TR-1004041, December 2001.
- **Iowa / Nebraska Distributed Wind Generation Projects First and Second-Year Operating Experience: 1999-2001**, U.S. Department of Energy - Electric Power Research Institute Wind Turbine Verification Program, EPRI TR-1004039, December 2001.
- **Project Performance in the DOE-EPRI Wind Turbine Verification Program**, America Wind Energy Association Conference Proceedings, June 2001.
- **Review of Operation and Maintenance Experience in the DOE-EPRI Wind Turbine Verification Program.** 13 pp.; NICH Report No. CP-500-28620.
- **Wisconsin Low Wind Speed Turbine Project First- and Second-Year Operating Experience: 1998-2000**, U.S. DOE - EPRI Wind Turbine Verification Program, EPRI TR-1000959, 2000.

- **Wind Turbine Verification Project Experience: 1999, U.S.**

Department of Energy - Electric Power Research Institute Wind
Turbine Verification Program, EPRI TR-1000961, June 2000.

16. Presentations I have given include two talks about patent law to mechanical and electrical engineering graduate students and professors at the University of Texas at El Paso in February and April of 1995. They also included a talk about Self-Erecting Wind Turbines at the National Renewable Energy Laboratory in September 2000 that included presentation of a tower-climbing crane for avoiding the use of large, expensive mobile cranes. I also gave several presentations related to wind turbine technology, that included discussions of wind farm operations and component replacement, to various investor groups in Boston, New York, and San Francisco in 2007 as well as a presentation to the Infocast investor conference in 2017 that included a discussion of risks related to wind turbine component failure rates and replacement costs. I also gave a presentation to AIG Insurance executives in 2012 that included a discussion of component failures and repair costs, including crane costs as a fraction of overall repair costs. Presentations I have given related to wind farm operations and maintenance include:

- **Opportunities In the US Wind Power Operations & Maintenance Service Sector**, Gerson Lehrman Group, May 2016.

- **Optimizing Turbines and Components, Optimizing Wind Power O&M**, Chicago, Il, Sept 2013.
- **Wind Turbines 101, Presented to AIG Insurance**, July 2012.
- **Cold Weather Operation Concerns** – Utility Wind Interest Group Workshop Anchorage, AK, June 2000.

17. I have attended the majority of all wind energy industry conferences since 1990, including conferences dedicated to operations and maintenance of wind farms. I chaired sessions at the American Wind Energy Association Windpower conferences in 2006, 2007, and 2012 and several of these sessions were related to wind farm operations and maintenance. I was on the Technical Committee planning the Global Windpower Conference in 2002. I was also the conference chair for the Green Power – Optimizing Wind Power O&M 2006 conference.

18. I have had an extensive role in developing technical standards for wind energy. I have been on the US Technical Advisory Group (US TAG) for the American National Standards Institute (ANSI) since 2001. The US TAG provides input on all international standards efforts related to wind energy standards, and provides US national voting on all proposed international standards. I have also been an appointed expert representing the US on various standards committees related to performance testing of wind turbines including for IEC 61400-12-1, IEC 61400-12-2, IEC 61400-12-3, and IEC 61400-50-3. I have served on the Wind

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Technical Standards Committee of American Clean Power (formerly the American Wind Energy Association) since 2001. I currently serve on the Renewable Energy Management Committee (REMC) of IECRE, the international organization that works to ensure consistent application of international standards related to renewable energy. I am also on the Board of Directors of ARESCA, the organization that organizes all international standards activities in the US related to wind energy, including management of the US TAG. I also serve on ARESCA's Standards Development Board.

19. I am being compensated at the rate of \$1,000 per hour for my work on this declaration. My fee is not contingent on the outcome of this or any matter or on any of the technical opinions I offer in this declaration.

20. I have no financial interest in Petitioner. I have been informed that Liftra claims ownership in the '578 Patent. I have no financial interest in Liftra.

III. UNDERSTANDING OF RELEVANT LEGAL PRINCIPLES

21. I am not a legal expert and I offer no opinions on the law. However, I have been advised by counsel about some of the legal principles relevant to an analysis of patentability of claims in a United States patent, as summarized below. I have conducted my analysis in accordance with these principles.

A. Prior Art and Priority

22. I understand that, for an invention claimed in a patent to be found patentable, or to be valid, it must be, among other things, new and not obvious in light of what came before it, which is referred to as “prior art.” I further understand that the frame of reference for determining whether a claim is obvious is from the perspective of a person of ordinary skill in the relevant art (“POSITA”) as of the effective filing date of the invention. I understand that the “priority date” or “effective filing date” of a patent is the date on which it is filed, or the date on which an earlier-filed U.S. or international patent application was filed if the patentee claims the benefit of priority to that earlier-filed application.

23. I have been informed that a patent’s disclosure consists of the information in the specification, along with any drawings that accompanied the patent application.

24. I have been informed that a patent claiming a set (*e.g.*, a range having a lower limit, upper limit, or both) must be supported by the patent disclosure.

25. I have been informed that one of the disclosure requirements is that the patent disclosure provide a sufficient written description of the claimed set (“written description” requirement).

26. I understand that in the patent application process, the applicant may keep the originally filed claims, or change the claims between the time the patent

application is first filed and the time a patent is issued. An applicant may amend the claims or add new claims. These changes may narrow or broaden the scope of the claims. I understand that a patent application is entitled to the benefit of the filing date of an earlier-filed application only if the disclosure of the earlier application provides support for the claims of the later application as required by the “written description” requirement. I further understand that for a patent application to have an adequate written description of the invention, it must show the inventor was in possession of the invention at the time the patent application was filed.

27. When determining whether a specification of a patent application contains adequate written description of the claimed invention, I understand that one must make an objective inquiry into the four corners of the specification from the perspective of a POSITA.

28. I have been informed that to satisfy that requirement, the earlier filed application must reasonably convey to those skilled in the art that the inventor had possession of the claimed subject matter. Evaluation of adequate written description requires an objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art. A description cannot merely render the invention obvious. Finally, I understand that the standard for whether or not a disclosure is sufficient to provide written description support for a claim is different from the standard for whether a disclosure anticipates a claim. To support

a claim, the description must be sufficient to convey to a POSITA that the inventors were in possession of the full scope of the claimed subject matter. By contrast, a description anticipates a claim if it discloses even a single embodiment within the scope of the claim. Thus, I understand that there can be situations in which a given disclosure is sufficient to anticipate the claim even though that same disclosure is not adequate to support the claim and entitle the inventors to an earlier priority date.

29. I understand that in order to claim priority to an application through a chain of applications, every single application in the chain (going back to the particular application on which the inventors want to rely) needs to support the claim as a matter of written description. In other words, each application in the chain must allow a person of ordinary skill in the art to discern that the inventors were in possession of the claimed invention at the time of the application. It is not sufficient under this standard for the disclosure in the specification to render the claimed invention obvious.

30. For purposes of my opinions in this declaration relating to Grounds 1-3, and based on the asserted chain of priority in the Challenged Patent, I assume that the effective filing date of the Challenged Patent is October 7, 2014, regardless of whether there is actually support in the chain of priority applications for all the claim limitations. As for Ground 4, and as discussed in more detail below, it is my opinion that a POSITA would not have understood the applicant of any applications in the

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priority chain of the '578 Patent to be in possession of the subject matter claimed in Claims 1 and 3-17 of the Challenged Patent. Therefore, it is my opinion that those claims lack written description support in the chain of priority applications and are not entitled to a priority date before January 24, 2024 (the filing date of the Challenged Patent), because none of the earlier filed applications that the '578 Patent lists on its face has written description support for the full claim scope.

31. I have been informed that a reference qualifies as prior art for determining anticipation or obviousness when it (i) was patented or published before the effective filing date of the claim in question under the criteria set out in 35 U.S.C. § 102(a)(1) or is a U.S. patent or published application that was effectively filed before the effective filing date of the claim in question under the criteria set out in 35 U.S.C. § 102(a)(2), (ii) is not subject to an exception under 35 U.S.C. § 102(b), and (iii) is analogous to the claimed invention. I further understand that prior art may be considered analogous if it is from the same field of endeavor, regardless of the problem addressed, as the claimed invention. I also understand that prior art may be considered analogous if it is “reasonably pertinent” to the particular problem with which the inventor is involved. I have been informed that a reference is “reasonably pertinent” if it is one which, because of the matter with which it deals, logically would have commended itself to an inventor’s attention in considering the inventor’s problem.

B. Standard of Proof

32. I understand that, in these proceedings, the burden is on the party asserting unpatentability to prove it by a preponderance of the evidence. I understand that “a preponderance of the evidence” is evidence sufficient to show that something is more likely than not.

C. Claim Construction

33. I understand that, unless otherwise construed by the U.S. Patent Trial and Appeal Board (“PTAB”) or a court, patent claims should be accorded their ordinary and customary meaning as understood by a POSITA as of the effective filing date, in light of the intrinsic record. The intrinsic record includes the patent’s specification and claims, as well as its entire prosecution history. I also understand that a patentee is free to be his or her own lexicographer and thus may use a term in a manner contrary to or inconsistent with its ordinary meaning, provided that the patentee makes the special meaning clear in the specification or as part of the record during prosecution.

34. I further understand that in construing claims, a POSITA is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification and the prosecution history. I understand that the construction that stays true to the claim language and most naturally aligns with the patent’s

description of the invention will generally be, in the end, the correct construction.

Although the claims themselves provide substantial guidance as to the meaning of particular claim terms, the claims do not stand alone.

D. Anticipation

35. I have been informed that a claim is anticipated when a single prior art reference discloses, either expressly or inherently, each and every claim element arranged in the order specified by the claim.

E. Obviousness

36. I have been informed that a patent claim is invalid as obvious only if it would have been obvious to a person of ordinary skill in the art as of the effective filing date, in light of the prior art. A claim is invalid as obvious if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious to a POSITA as of the effective filing date. The prior art may include one or more references that a POSITA trying to solve the problem that the inventor addressed would likely have considered, as well as the body of knowledge that a POSITA would possess.

37. I have been informed that, in evaluating obviousness, one must consider: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; and (3) the level of ordinary skill in the art. In addition, I understand that objective indicia of non-obviousness, also known as “secondary

considerations,” might be utilized to give light to the circumstances surrounding the origin of the claimed subject matter. I understand that secondary considerations can include, for example, evidence of commercial success of the alleged invention, evidence of a long-felt but unmet need that was solved by an invention, failure of others, evidence that others copied the alleged invention, or evidence that the alleged invention achieved a surprising result. I further understand that such evidence must have a nexus to the elements of a claim in order to be relevant.

38. I have been informed that, although a challenger may rely on a combination of separate prior art references to support an obviousness challenge, a person of ordinary skill in the art as of the effective filing date should have had some motivation or reason to combine the references in such a way as to arrive at the claimed invention. That motivation can come from the problem the invention purports to solve, from other references, from the teachings of those references showing the invention is obvious, from market incentives, or from the common-sense knowledge of a person of ordinary skill in the art. Any need or problem known in the field at the time of the effective filing date and addressed by the patent can provide a reason for combining elements. However, obviousness findings grounded in common sense must contain explicit and clear reasoning providing some rational underpinning why common sense compels a finding of obviousness. A motivation

to combine requires more than the mere fact that a POSITA could have made the combination.

39. I have been informed that assessing which prior art references to combine and how they may be combined to match the asserted claim may not be based on hindsight reconstruction or ex-post reasoning. That is, one must view the prior art forward from the perspective of the person of ordinary skill in the art as of the effective filing date, not backwards from the current time through the lens of hindsight. It is my understanding that it is improper to use a patent claim as a template or road map to the prior art, and to pick and choose prior art references to meet the elements of that claim to show obviousness.

40. I understand that a combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I further understand 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.

41. I understand that, when there is a reason to solve a problem and there are 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 further understand 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.

IV. SUMMARY OF MATERIALS REVIEWED AND CONSIDERED

42. All of the opinions contained in this Declaration are based on the documents I reviewed and my knowledge and professional judgment. In forming the opinions expressed in this Declaration, while drawing on my experience in the field of developing, designing, inspecting, maintaining, and repairing wind turbine power generation equipment mounted in the nacelle of a wind turbine (including my teaching, research, and consulting experiences), I reviewed the Challenged Patent, its file history, the prior art, and all exhibits cited in this declaration, including the documents in the Table of Exhibits submitted with the IPR Petition filed concurrently with this Declaration.

43. I may rely upon these materials and/or additional materials to rebut arguments raised by Liftra. 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.

44. My opinions are additionally guided by my appreciation of how a POSITA would have understood the claims of the Challenged Patent as of the effective filing date of the alleged invention, which I assume is October 7, 2014 for Grounds 1-3 and January 24, 2024 for Ground 4.

V. BACKGROUND OF THE TECHNOLOGY

45. Wind energy emerged as a utility-scale generation technology in the early 1980s, spurred by tax credits from the US government and from the state of California. The wind turbines installed in the 1980s were small by comparison to today's wind turbines. Most were between 50 kW to 250 kW in capacity (enough to power approximately 10 to 50 houses) and had rotors with diameters in the range of 15 to 25 meters (50 to 82 feet) perched atop towers that were 20 to 30 meters tall (65 to 98 feet).¹ Many of these early wind turbines were unreliable, at least partly as a result of their low specific mass, and were dismantled after a short time.² However, some of the wind turbines installed in the early to mid-1980s are still in operation today. Most of those still-operational wind turbines that turned out to be more reliable were built by Danish companies, at least one of which previously manufactured tractors and other farm equipment for Danish farmers. The reliable

¹ Ex. 1025 (An Overview of the History of Wind Turbine Development: Part II-The 1970s Onward, Gipe and Mollerstrom, Wind Engineering 1-29 (2022)) at Table 5 (p. 25).

² See Ex. 1025 (An Overview of the History of Wind Turbine Development: Part II-The 1970s Onward, Gipe and Mollerstrom, Wind Engineering 1-29 (2022)) at p. 20-21 ("Lightweights in a heavyweight environment").

Danish wind turbines from the early to mid-1980s were over-designed and were stout – much like tractors and other farm equipment. Because of the relatively short tower height for these early wind turbines, cranes to erect and service them were plentiful and inexpensive.

46. During the 1990s, engineers' understanding of the loads experienced by wind turbines improved considerably. That allowed wind turbines to both grow in size and be designed with smaller design margins. For example, by the end of the 1990s, Enron Wind (formerly Zond Corporation) was manufacturing wind turbines rated at 750 kW (enough to power approximately 280 households) and had a rotor diameter of 46 to 50 meters (151 feet to 164 feet) on towers that were 55 to 65 meters tall (180 feet to 213 feet).³ These wind turbines were reasonably reliable, and when repairs were needed cranes were still plentiful and affordable.

47. By the end of the 1990s, even larger wind turbines were being designed, and engineers began to question what the constraints would be on wind turbine size. A research program at the National Renewable Energy Laboratory looked at scaling effects of various aspects of wind turbines in an attempt to answer this question. One study examined crane costs as wind turbines grow in size, and determined that cranes

³ See Ex. 1028 (Wind Power Today – 1998 Wind Energy Program Highlights, US Department of Energy, DOE/GO-10099-820, June 1998) at Pages 6-7 of 32.

become a less efficient component of construction and maintenance cost for wind turbines larger than about 2.5 MW.⁴ As a result, the same research program investigated alternatives to cranes for installation of wind turbines in the form of self-erecting wind turbines.⁵ The self-erecting wind turbine study also considered the applicability of technologies to maintenance activities.

48. In the 2000s, wind farm development activity increased significantly in the United States. As a result, investments in wind turbine technology also increased, and there were many developments in wind turbine technology throughout the 2000s. By the end of the decade, large companies such as GE, Siemens, and Mitsubishi had entered the industry. Wind turbines grew in size during the decade from 750 kW to 2.5 MW (large enough to power approximately 750 households) with rotor diameters of approximately 100 meters (328 feet) and tower heights were approximately 80 meters (262 feet). Cranes had become a major

⁴ See Ex. 1030 (WindPACT Turbine Design Scaling Studies Technical Area 2: Turbine, Rotor, and Blade Logistics, Kevin Smith, NREL/SR-500-29439, June 2001) at Page 66 of 224.

⁵ See Ex. 1031 (WindPACT Turbine Design Scaling Studies Technical Area 3: Self-Erecting Tower and Nacelle Feasibility, NREL/SR-500-29493, May 2001) at Pages 4-6 of 72.

contributor to the costs of operations and maintenance for this size of wind turbine. Furthermore, because the technology had developed quickly during the decade, and safety margins further reduced, a large number of gearboxes and generators were experiencing failures. In order to reduce operations and maintenance costs, companies began developing technologies to allow replacement of major components without the need to bring in a large crane.⁶

49. Around 2007 to 2009, in part due to the financial difficulty and recession in the macro economy, there was consolidation within the wind energy industry, as well as increased competition for wind turbine sales. There were also incentives for wind energy built into the American Recovery and Reinvestment Act of 2009.⁷ As a result, many wind turbine manufacturers accelerated development of

⁶ For example, see comments from Clipper Windpower's Bob Gates about their wind turbine's on-board crane capabilities and efforts to increase activities that can be performed up-tower without a crane. See Ex. 1029 (Wind Turbines - Designing With Maintenance In Mind, Power Engineering, Volume III, Issue 5, May 1, 2007 (available at <https://www.power-eng.com/renewables/wind-energy/wind-turbines-designing-with-maintenance-in-mind/>)) at Pages 7-8 of 15.

⁷ Ex. 1040 (IRS Fact Sheet, Energy Provisions of the American Recovery and Reinvestment Act of 2009 (ARRA), FS-2009-10, April 2009).

new wind turbine models. Further, many wind turbine manufacturers de-emphasized service for their wind turbines during this timeframe, providing short warranties (two to five years) and leaving wind farm owners to maintain wind turbines after expiration of the warranty.⁸ The increasing maintenance costs created a motivation for wind farm owners to find cost savings, including up-tower repairs that avoid the cost of a mobile crane.

50. The late 2000s and early 2010s saw the emergence of many different methods and components for performing up-tower maintenance and component replacement, as well as the development of components that were easier to replace

⁸ Ex. 1029 (explaining that a typical warranty was for two to five years, but owners often opted for the cheaper, shorter warranty) at Pages 3-4 of 15.

up-tower.^{9,10,11,12} The field became crowded with these solutions, as reflected, for example, in the documents referenced in this Declaration, including Signore, Weaver, Hanxing, Power Climber, Stegemann, Holloway, Weitkamp, Cooper, Schaeffler, and Guerenbourg. Several factors motivated developments at that time, including: (i) wind turbine owners being largely responsible for performing unscheduled maintenance activities (replacing main components such as blades, bearings, gearbox, and generator when they fail) on their own, (ii) failure rates of

⁹ Ex. 1036 (Moventas Expands Up-tower Service With Mobile Service Units, Windpower Engineering & Development, February 8, 2013).

¹⁰ Ex. 1037 (NextEra Energy Resources Generation Repair & Service Overview, Slide 12, November 15, 2013, available at <https://home.engineering.iastate.edu/jdm/WESEP594/BarriosNextEra.pdf>).

¹¹ Ex. 1038 (New Vestas Wind Turbine, Crane Blogger, May 14, 2009, available at <https://www.craneblogger.com/new-cranes/new-vestas-wind-turbine/2009/05/14/>).

¹² Ex. 1039 (Press Release, Timken Acquires Wazee Companies, LLC; Expands Industrial Service Offerings, January 2, 2013, available at <https://news.timken.com/2013-01-02-Timken-Acquires-Wazee-Companies-LLC-Expands-Industrial-Service-Offerings>) (describing that the acquisition “brings Timken...uptower wind maintenance and repair”).

main components increasing, and (iii) large mobile cranes responsible for a large portion of overall maintenance costs, there was a push in the industry to develop methods for performing up-tower maintenance and component replacement, as well as development of components that were easier to replace up-tower.

VI. LEVEL OF SKILL IN THE ART AND PERSPECTIVE APPLIED IN THIS DECLARATION

51. In determining the level of ordinary skill, I have been asked to consider, for example, the types of problems encountered in the field, prior solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. Taking those factors into consideration, a person of ordinary skill in the art at the time of the claimed priority date of the Challenged Patent (October 7, 2014) would have had at least a Bachelor's of Science degree in Mechanical Engineering or an equivalent field and five or more years of experiencing working in the field of wind turbine design and/or operations. This experience would include familiarity with the use of cranes for performing maintenance activities on a wind turbine and experience related to the repair or replacement of major components on a wind turbine. The relevant experience would further include having spent sufficient time working inside the nacelles of wind turbines in order to appreciate the logistics and human factors involved in performing up-tower maintenance activities inside a nacelle. However, additional years of education in the above-referenced fields may

compensate for fewer years of experience. For Claims 1 and 3-14, for which it is my opinion that they are entitled to a priority date no earlier than January 24, 2024, a POSITA at that time would have had the same amount of education/experience described above. However, because of the advancements in technology between 2014 and 2024, that same amount of education and experience would provide a POSITA in 2024 with a more expansive level of skill and knowledge as compared to 2014.

52. Based on my background and experience, I would have qualified as a person of at least ordinary skill in the art at least as of October 7, 2014 and would have continued to qualify as a POSITA as of January 24, 2024. I further believe that I have a sufficient level of knowledge, experience, and education to provide an expert opinion in the field of the Challenged Patent.

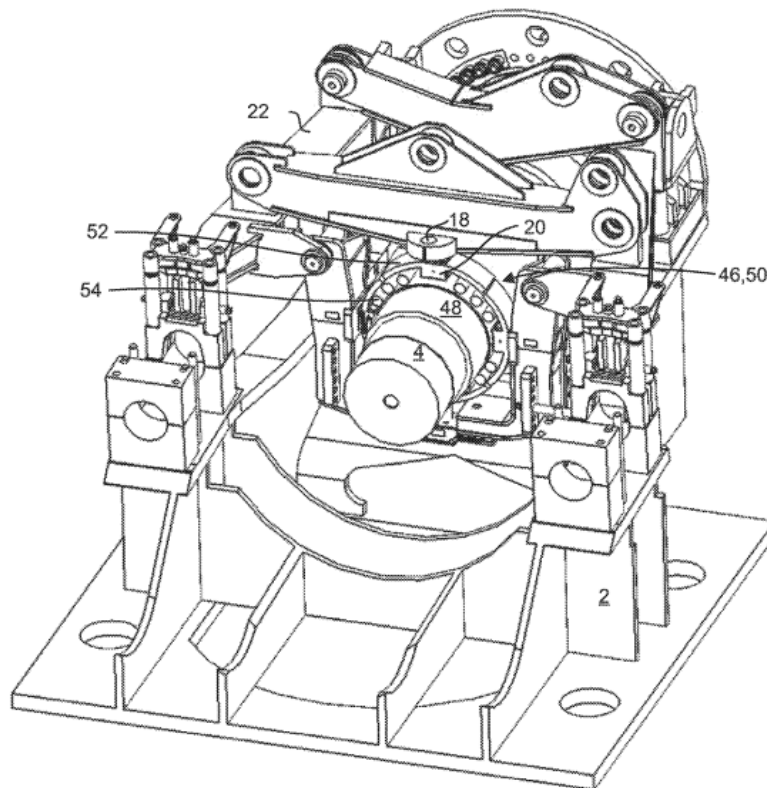
53. For Grounds 1-3, my opinions in this Declaration are based on the perspective of a POSITA as of October 7, 2014 or somewhat before. For Ground 4, my opinions in this Declaration are based on the perspective of a POSITA as of January 24, 2024 or somewhat before. This is true even if the testimony is stated in the present tense. Each of the statements below reflects my opinion based on my review of the disclosures of the Challenged Patent, the file history of the Challenged Patent, and the Challenged Claims.

VII. THE CHALLENGED PATENT

A. Summary of the Specification

54. The Challenged Patent describes well-known apparatuses for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine.

55. The disclosed apparatus comprises a main shaft fixture used for fixing a main shaft on a wind turbine during installation and repair work on heavy parts of the wind turbine nacelle. Ex. 1001, Abstract. An embodiment of the main shaft fixture is depicted in Figure 5 below.



56. The '578 Patent describes that the fixture may be “formed of several sections for mounting on stable structural parts in the nacelle, including the nacelle’s bottom frame.” Ex. 1001, (57) Abstract. As described in the Specification, “[t]he main shaft fixture has adjustable pressure mandrels with tap shoes, ... facilities for mounting of a lightweight crane and a self hoisting crane with a ground-based winch, respectively, as well as a rotor lock which, in combination with actuators of the main shaft fixture, enables the main shaft and the main shaft bearing to be sufficiently displaced vertically from its bearing in the nacelle to service or replace the bearing.” *Id.*

57. As the '578 Patent describes, “main shaft fixture[s] for fixing the main shaft on a wind turbine during the execution of installation and repair work on heavy parts that are arranged in the nacelle on wind turbines” were well known in the art. Ex. 1001, at 1:44-48 (citing German Patent Application DE 102006013539 A1 (NORDEX ENERGY GMBH)). It was also well known that such main shaft fixtures could be “divided up into a number of sections for installation on stable structural parts that are found on a wind turbine nacelle, including the bottom frame of the nacelle.” *Id.* at 1:48-51. Further, it was well known that a “rotor lock” could be used to halt the turbine during repairs. *See id.* at 1:52-56. The '578 Patent also admits that it was well known to use “self-hoisting cranes” to raise “large and heavy components” into the nacelle of a wind turbine rather than using “large mobile

cranes” on the ground. *Id.* 1:66-2:5. Finally, the ’578 Patent admits that it was well known to use “a lightweight crane” mounted in the nacelle “for the hoisting of snatch blocks, etc., that are to be anchored on/in the nacelle or on the blades of the wind turbine.” *Id.* at 2:7-13.

58. However, according to the ’578 Patent, the prior art generally required that repair personnel “halt the turbine, *i.e.*, brake it and fix the rotor with a rotor lock, and then mount an actual fixture to firmly hold the main shaft, subsequent to which servicing of the components in the wind turbine nacelle is able to take place.” *Id.* at 1:52-56. The ’578 Patent also explains that it was “inappropriate to have to halt the operation of the wind turbine while the mounting of the main shaft fixture is taking place,” as halting the operation resulted in “a not insignificant operating loss in the form of a lack of energy produced (power).” *Id.* at 1:56-61. Further, because the prior art main shaft fixtures were “inflexible in relation to shaft geometry,” “just as many different fixtures need to be built and stored as there are shaft geometries that exist,” which the ’578 Patent describes as “inappropriate.” *Id.* at 1:62-66.

59. As such, the “purpose” of the alleged invention of the ’578 Patent was “a main shaft fixture that provide[s] a more universal application in relation to shaft geometry, which moreover does not require halting and fixing of the wind turbine main shaft, but which may however comprise the means for such,” and to “provide a main shaft fixture that [itself] offers facilities for the mounting of a self-hoisting

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crane” or “a lightweight crane.” *Id.* at 2:26-33, 2:42-43. The ’578 Patent sought to
provide “a more universal application in relation to shaft geometry” by utilizing
multiple “adjustable pressure mandrels with tap shoes” that are “displaceable
between a passive, withdrawn lockable position where the tap shoes are configured
to be located at a distance from the surface of the main shaft and an advanced
lockable position where the tap shoes are configured to be engaged with the main
shaft.” *Id.* at 2:26-30, 2:37-42.

60. Figures 2 and 5 of the ’578 Patent, excerpted and annotated below, each
illustrate embodiments of the claimed main shaft fixture with four adjustable
pressure mandrels (pink) with tap shoes (red) with a main shaft (blue):

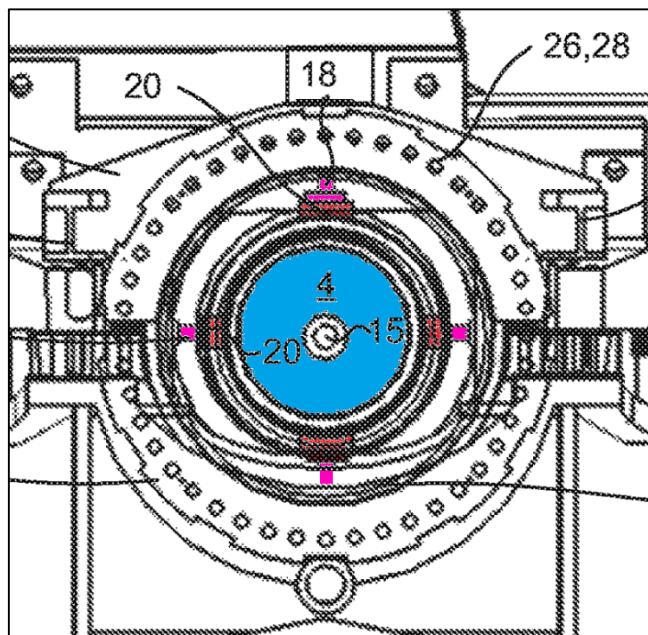


Figure 2

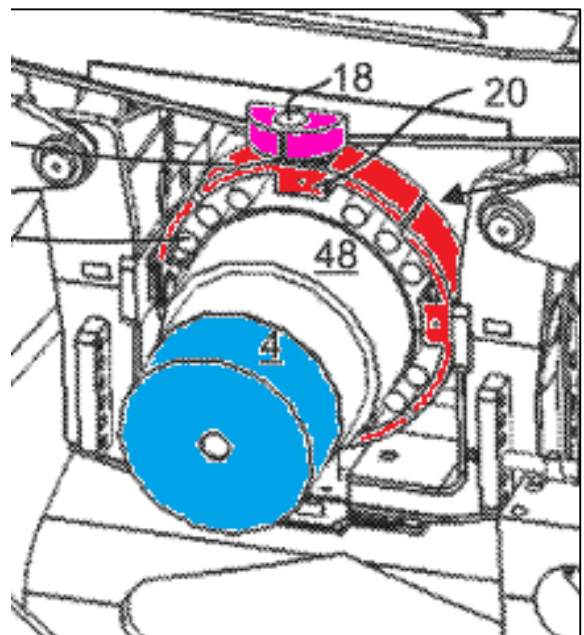


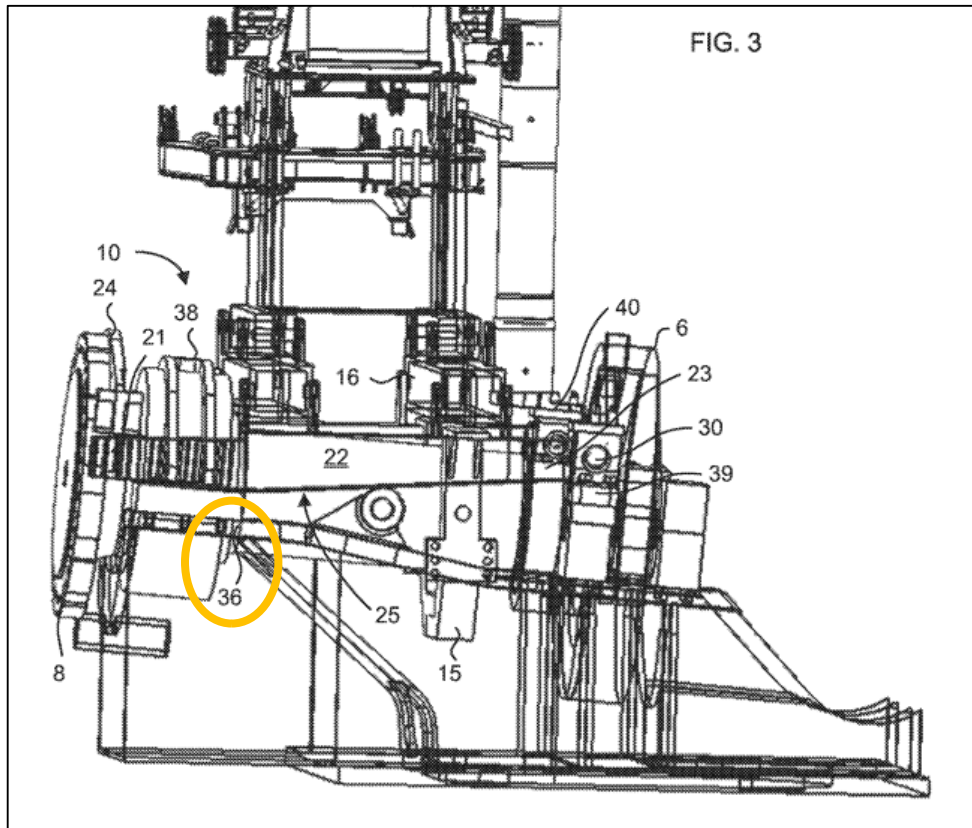
Figure 5

Id. at Figs. 2 and 5 (annotated); *see also id.* at 4:63-5:2 (“FIG. 5 is a detailed perspective view of the main shaft fixture for a wind turbine ... [including a] multi-part outer ring consisting of bowed sub-segments of the number of tap shoes....”). In addition, the ’578 Patent discloses an embodiment “where the tap shoes and the main shaft are furnished with slide plates,” *id.* at 4:61-62, “which is specially suited for use for fixing the wind turbine main shaft 4 in position on the nacelle, but where rotation of the main shaft 4 is possible, in the active position of the pressure mandrels/tap shoes (18, 20), engaged with the main shaft.” *Id.* at 6:4-9. The ’578 Patent further describes additional embodiments where shaft rotation is permitted by “multi-part needle bearing, roller bearing, [or] ball bearing 46, [which] involves the main shaft 4 being permitted to rotate simultaneously with it being fixed in its position during servicing of the wind turbine, which can serve a purpose namely for larger wind turbines.” *Id.* at 6:46-51.

61. Further, the ’578 Patent discloses “being able to perform replacement of the shaft’s main bearing, without being forced to dismount the main shaft,” wherein the main shaft fixture “comprise[s] at least a second actuator [(orange in ’578 Patent Figure 3 below)], between the nacelle’s bottom frame and the opposing side of the first beam-shaped brackets facing such and the nearest rotor lock, where the [additional] actuator is movable between a first passive outer position and an

active outer position whereby the [main shaft] flange element is moved vertically.”

Id. at 4:27-36.



62. Finally, the '578 Patent discloses “combining the main shaft fixture with facilities 40 for mounting of a lightweight crane 12 and a self-hoisting crane 14 with a ground-based winch, respectively....” *Id.* at 6:61-63.

63. In my opinion and as discussed in detail below, these concepts were well-known by no later than October 7, 2014, particularly in view of Signore, Weaver, Stegemann, Holloway, Power Climber, Schulz, Hanxing, Cooper, Schaeffler, and Guerenbourg. The components of the patent are conventional and operate in a conventional manner.

64. In my opinion, and as described in detail throughout this declaration, there is nothing unconventional, unexpected, or surprising about the claimed components, their configuration, or how they operate.

B. Prosecution History of the Parent '518 Patent

65. In the prosecution of United States Patent No. 10,378,518 (the "'518 Patent") (Ex. 1005), a parent to the challenged '578 Patent, the examiner issued a Non-Final Rejection on June 29, 2018, rejecting pending claim 1 as obvious over U.S. Pat. Application No. 2012/0141292 ("Signore") (Ex. 1007) in view of European Patent No. 1,748,182 ("Weaver") (Ex. 1008), and finding that radially displaceable pressure mandrels with tap shoes were not inventive:

Signore does not disclose at least three radial displaceable pressure mandrels, and a tap shoe is provided on a first end of the pressure mandrel. However, Weaver discloses a shaft restraining member 400 attached to a bed plate of a wind turbine. The shaft restraining member includes hydraulic or mechanic operated friction brakes 518. The clamping action of brakes 518 resists torque from rotor shaft 402. The hydraulic or mechanic brake may comprise cylinders supported on brake support flange 519 of the shaft restraining member.

Ex. 1006 (Prosecution History of '518 Patent), at 98 (June 29, 2018 Non-Final Rejection, at 5-6). However, the Examiner found that pending claim 11, which claimed a "rotor lock," but *no* radially displaceable pressure mandrels with tap shoes, "would be allowable if rewritten in independent form including all of the limitations

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of the base claim and any intervening claims.” *Id.* at 102 (June 29, 2018 Non-Final
Rejection, at 9).

66. In response, the applicant amended pending claim 11 to include all
limitations of rejected pending claim 1, including the “radially displaceable pressure
mandrels ... substantially symmetrical located around a centre axis.” *Id.* at 66-67
(October 1, 2018 Amendment, at 5-6).

67. On January 31, 2019 the Examiner again rejected pending claim 1,
finding that:

***[I]t would have been obvious to one with ordinary skill
in the art before the effective filing date of the claimed
invention to modify the torque clamps of Signore to be
hydraulic or mechanical operated such that its radial
position can be adjusted to fit the main shaft with desired
friction.*** Signore as modified by Weaver teaches that at
least three radial displaceable pressure mandrels, first ends
of said pressure mandrels face the main shaft and are
furnished with a tap shoe (the torque clamps), and wherein
said pressure mandrels are displaceable between a passive,
withdrawn lockable position where the tap shoes are
configured to be located at a distance from the surface of
the main shaft and an advanced lockable position where
the tap shoes are configured to be engaged with the main
shaft. ***Signore as modified by Weaver teaches that the***

***pressure mandrels are substantially symmetrical[ly]
located around a center axis of the main shaft.***

Id. at 42 (January 31, 2019 Final Rejection, at 4) (emphasis added).

68. However, the Examiner allowed pending claim 11, which contained “radially displaceable pressure mandrels” limitations nearly identical to those of pending claim 1, but also contained limitations directed to a rotor lock integral to the main shaft fixture. See Exhibit 1005 (’518 Patent) at issued Claim 1 (“A main shaft fixture (10) ... comprising a rotor lock (24) for fixation of the rotor (8) of the wind turbine ...”). Further, the Examiner found that “[r]egarding the intended use limitation ‘The three independently, radially displaceable pressure mandrel is for fixing of cylinder-shaped with different diameters and for the fixing of shafts with conical shapes[.]’, it is noted that the prior art used in the rejection is capable of being used for this function.” Ex. 1006, at 43 (January 31, 2019 Final Rejection, at 5). As such, it was clear that the claimed “radially displaceable pressure mandrels” were obvious, and could not be a basis for patentability.

C. Prosecution History of the Challenged ’578 Patent

69. In the prosecution of the ’578 Patent, the applicant presented a preliminary amendment to pending claim 1 that was substantially similar to the rejected pending claim 1 of the ’518 Patent, except that it excluded a number of the original limitations and added a requirement for “mounting facilities adapted for

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anchoring a crane on/in a nacelle of a wind turbine.”¹³ The rejected version of
pending claim 1 of the ’518 Patent and the preliminary amendment to pending claim
1 in the prosecution history of the ’578 Patent are shown side-by-side in the table
below, with the excluded language from rejected claim 1 of the ’518 Patent shown
in red strikethrough and added language from the preliminary amendment to claim
1 in the prosecution history of the ’578 Patent shown in blue underline.

¹³ I note that the applicant’s preliminary amendment to the claims during
prosecution of the ’578 Patent reflect changes that do not correspond to the initially
submitted claims. *Compare* Ex. 1002 at 134 (preliminary amendment reflecting
that pre-amended claim 1 was directed to a “Main shaft fixture”) *with id.* at 174
(initially submitted claim 1 directed to “A self-hoisting crane”). A correct
reflection of the changes between the initially submitted claim 1 and the
preliminary amendment to claim 1 is attached hereto as Appendix A.

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Rejected Pending Claim 1 of the '518 Patent ¹⁴	Pending Claim 1 of the '578 Patent ¹⁵
~~A~~ main shaft fixture ~~(10)~~ for fixation of a main shaft ~~(4)~~ on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine, where the fixture ~~(10)~~ is divided up into a number of sections for mounting on stable structural parts ~~(2)~~ in a nacelle ~~in~~ a wind turbine, including the bottom frame ~~(2)~~ of the nacelle, ~~wherein~~ the main shaft fixture ~~(10)~~ comprises ~~at least three independently, radially displaceable~~ pressure mandrels ~~(18) for fixing of cylinder-shaped shafts with different diameters and for the fixing of shafts with conical shapes, the pressure mandrels being substantially symmetrical located around a centre axis (11) of the main shaft, first ends of said pressure mandrels (18) face the main shaft (4) and are furnished with a~~ tap shoe ~~(20)~~, and ~~wherein~~ said pressure mandrels ~~(18)~~ ~~are~~ displaceable between a passive, ~~withdrawn lockable~~ position where the tap shoes ~~(20)~~ are configured to be located at a distance from the surface of the main shaft ~~(4)~~ and an ~~advanced lockable~~ position where the tap shoes ~~(20)~~ are configured to be engaged with the main shaft ~~(4)~~ in ~~a manner enabling the main shaft to be~~	Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine, where the fixture is divided up into a number of sections for mounting on stable structural parts in a nacelle <u>of</u> a wind turbine, including the bottom frame of the nacelle, <u>characterised in, that</u> the main shaft fixture comprises <u>adjustable</u> pressure mandrels with tap shoes, and said pressure mandrels <u>being</u> displaceable between a passive position where the tap shoes are configured to be located at a distance from the surface of the main shaft and an <u>active</u> position where the tap shoes are configured to be engaged with the main shaft <u>and in that said</u> main shaft fixture <u>further comprises mounting facilities adapted for anchoring a crane</u>

¹⁴ Exhibit 1006 ('518 Patent Prosecution History) at 64 (October 1, 2018

Amendment, at 3).

¹⁵ Exhibit 1002 ('578 Prosecution History) at 134 (January 24, 2024 Preliminary

Amendment, at 3).

~~fixed in position by the~~ main shaft fixture
~~while being permitted to rotate.~~

on/in a nacelle of a wind
turbine.

70. On April 26, 2024, the examiner issued a Non-Final Rejection, rejecting pending claims 1-4, 6-9, 10, and 13-14 as obvious over Signore in view of Weaver, and finding, as was the case in the prosecution of the '518 Patent, that radially displaceable pressure mandrels with tap shoes were obvious. See Exhibit 1002 at 87-88 (April 26, 2024 Non-Final Rejection, at 5-6). The Examiner further concluded that “Weaver et al teaches a shaft restraining member (400) attached to a bed plate of a wind turbine. The shaft restraining member includes hydraulic or mechanic operated friction brakes (518). The clamping action of brakes (518) resists torque from rotor shaft (402). The hydraulic or mechanic brake comprises cylinders supported on brake support flange (519) of the shaft restraining member (see Figures 4-5 and paragraphs [0016-0019]).” *Id.* at 88. The Examiner also found “mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine” obvious:

Although Signore does not specifically mention mounting facilities for a self-hoisting crane, it is noted that the structure of the main shaft fixture is capable for mounting with a self-hoisting crane, such as by using a chain or a cable connected between the crane and the main shaft fixture.

Id. at 88.

71. In the Non-Final rejection, the Examiner issued no prior art based rejections to Claims 5, 9, 11, and 12.

72. On July 26, 2024, the applicant responded to the Non-Final Rejection and argued that “the cited references fail to disclose or suggest, *inter alia*, ‘that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine,’ as recited in [pending] independent claim 1.” Ex. 1002 (Prosecution History of ’578 Patent) at 73-74 (July 26, 2024 Response to Non-Final Rejection, at 8-9). The applicant asserted that “[t]he Office Action does not rely on any reference to disclose this recitation, which was added to claim 1 in the Preliminary Amendment filed on January 24, 2024. Instead, the Office Action refers to independent claim 1’s previous recitation, prior to amendment by the Preliminary Amendment, of ‘suitable for a lightweight crane.’” *Id.* at 74. However, contrary to applicant’s assertion, nowhere in the Non-Final Rejection did the examiner refer to the previous recitation of “suitable for a lightweight crane.” The applicant’s originally submitted claim 1 did not even recite “suitable for a lightweight crane.” *See id.* at 174. Further, as discussed above, the examiner did point to Signore for this limitation.

73. Moreover, the Preliminary Amendment to Claim 1 referred to by the applicant was as follows: “...and in that said main shaft fixture further comprises mounting facilities ~~40 suitable for a lightweight crane~~ adapted for anchoring a crane

at 134 (January 24, 2024 Preliminary Amendment, at 3). To the extent the Non-Final Rejection had referred to “suitable for a lightweight crane,” it is my opinion that would have been equally applicable to the amended language of “adapted for anchoring a crane on/in a nacelle of a wind turbine” because if the prior art taught “mounting facilities suitable for a lightweight crane,” that would also teach “mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.”

74. In responding to the examiner’s prior art-based rejections, the applicant made no other arguments and did not address any other claim limitations. The applicant did make minor amendments to pending Claim 1, but none related to the “mounting facilities” limitation.¹⁷ The applicant also added new Claims 15-17.

75. Following the applicant’s response, the pending claims were allowed and issued as the ’578 Patent. As the “Reasons for Allowance,” the examiner stated

¹⁶ This reflects the applicant’s alleged changes. As discussed above, those changes did not correspond to the initially submitted claim.

¹⁷ On July 26, 2024 Patent Owner amended pending claim 1 to, among other typographical edits, correct an improper reference to “said pressure mandrels,” which lacked an antecedent basis, to instead recite “the adjustable pressure mandrels.” See Ex. 1002 at 67-72.

only: “The prior art of record neither anticipates nor renders obvious the claimed subject matter of the instant application as a whole either taken alone or in combination. In particular, the prior art of record does not teach the main shaft fixture further having mounting facilities adapted for anchoring a crane on or in a nacelle of a wind turbine.” Ex. 1002 (Prosecution History of ’578 Patent) at 26 (August 15, 2024 Notice of Allowance, at 2).

76. Throughout the course of prosecution, Claims 5, 9, 11, 12, 15, 16, and 17 faced no prior art based rejection before allowance.

77. In connection with allowing the claims, the examiner provided his search strategy and results following the applicant’s response to the non-final rejection. Ex. 1002 (Prosecution History of ’578 Patent) at 46-49 (August 15, 2024 Examiner’s Search Strategy and Results) (showing searches timestamped August 6, 2024). The examiner performed 20 searches, but only three were not duplicative of his initial searches leading to the non-final rejection. Although the “crane” limitation was the focus on the applicant’s response to the non-final rejection and the examiner’s reasons for allowance, only one of the three new searches included the term “crane”:

(Main ADJ shaft ADJ fixture) AND (main ADJ shaft) AND (wind ADJ turbine) AND (heavy ADJ parts) AND (wind ADJ turbine) AND (number WITH sections) AND (stable ADJ structural ADJ parts) AND (nacelle WITH wind ADJ turbine) AND (bottom ADJ frame WITH nacelle) AND (adjustable ADJ pressure ADJ mandrels) AND (tap ADJ shoes) AND (passive ADJ position) AND distance AND (surface

WITH main ADJ shaft) AND (active ADJ position) AND (mounting
ADJ facilities) AND crane AND (nacelle WITH wind ADJ
turbine).clm.

See id. at 48-49 (emphasis added). This search used eighteen separate terms, all connected by “AND.” The use of “AND” in between terms means that every separate term must be present in a document to produce a hit. Because the examiner’s search required eighteen different terms all to be present, this was a very narrow search and would have excluded potentially meaningful results.¹⁸

¹⁸ The examiner also repeated many of the searches he performed before the non-final rejection. One of those searches was for the Cooperative Patent Classification (CPC) code F03D13/10.CPC. Ex. 1002 (Prosecution History of ’578 Patent) at 47 (August 15, 2024 Examiner’s Search Strategy and Results); *see id.* at 98 (April 26, 2024 Examiner’s Search Strategy and Results). That CPC code is for “Assembly of wind motors; Arrangements for erecting wind motors.” *See* <https://www.uspto.gov/web/patents/classification/cpc/html/defF03D.html#F03D13/10>. The USPTO definition of this CPC code further states that “[a]ttention is drawn to the following places, which may be of interest for search:” and lists “Cranes in general B66C.” *Id.* However, no searches using the B66C CPC code appear in the examiner’s search strategy.

D. Claims

78. The '578 Patent has 17 claims, of which all (Claims 1-17) are challenged. Claims 1, 15, and 16 are independent. Each Challenged Claim of the '578 Patent refers to a main shaft fixture divided up into sections and that is used for fixture or fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine, where the main shaft fixture includes adjustable pressure mandrels with tap shoes and mounting facilities for anchoring a crane.

VIII. CLAIM CONSTRUCTION

79. In my analysis, I have applied the plain meaning of the terms and phrases in the claims as a POSITA would have understood those terms and phrases as of October 7, 2014 (for Grounds 1-3) and January 24, 2024 (for Ground 4). However, it is my opinion that the prior art relied on in the grounds set forth below discloses the subject matter of the challenged claims under any reasonable construction, including their plain meaning.

80. Independent Claims 1, 15, and 16 recite, among other elements, “facilities adapted for anchoring a crane.” The specification provides little support for what such “facilities” entail. The Description of Related Art describes “the use of self-hoisting cranes, whose winches are placed on the ground surface near the turbine’s tower...” as prior art. Ex. 1001, 1:66-2:1. It also references, as prior art,

“the presence of a lightweight crane, for the hoisting of snatch blocks, etc., that are to be anchored on/in the nacelle or on the blades of the wind turbine....” *Id.* at 2:8-10. The Description of Related Art further describes a “need for facilities for anchoring the self-hoisting crane” and requirements for “facilities for mounting the lightweight crane.” *Id.* at 2:5-6, 2:11-12. The Summary of the Invention states that the fixture “offers facilities for the mounting of a self-hoisting crane....” *Id.* at 2:31-33. The Summary of the Invention states that the purported “advance” of the fixture is that “the establishment of facilities for fixing of the wind turbine’s main shaft, as well as the establishment of mounting facilities for the self-hoisting crane with a ground-based winch, take place simultaneously....” *Id.* at 2:61-64. The Detailed Description of the Invention describes that the main shaft fixture 10 is shown “bearing a lightweight crane 12 and a self-hoisting crane 14 with a ground-based winch (not shown), respectively.” *Id.* at 5:10-13. The Detailed Description of the Invention also states that in Figure 2 “bracket facilities 23 are seen for a self-hoisting crane 14 with a ground-based winch (not shown).” *Id.* at 5:54-56. Finally, the Detailed Description of the Invention states that the device combines “the main shaft fixture with facilities 40 for mounting of a lightweight crane 12 and a self-hoisting crane 14 with a ground-based winch, respectively....” *Id.* at 6:61-63. The ’578 Patent does not provide more detail than this about the “facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.” Given the lack of detail

provided, I interpret the term “facilities adapted for anchoring a crane” to describe any kind of bracket, anchor point, tether point, or other equipment that can “facilitate” the anchoring of a crane. I note that the claim does not require that an “anchor” be provided on the shaft fixture; instead, only “facilities adapted” for anchoring a crane are required. In the absence of any description providing more detail, a POSITA would understand that these “facilities adapted for anchoring a crane” are no different than any other anchor point that might be found within a nacelle of a wind turbine, and that no special, unexpected, or unanticipated advantage is described that results from the provision of these “facilities.”

IX. THE PRIOR ART

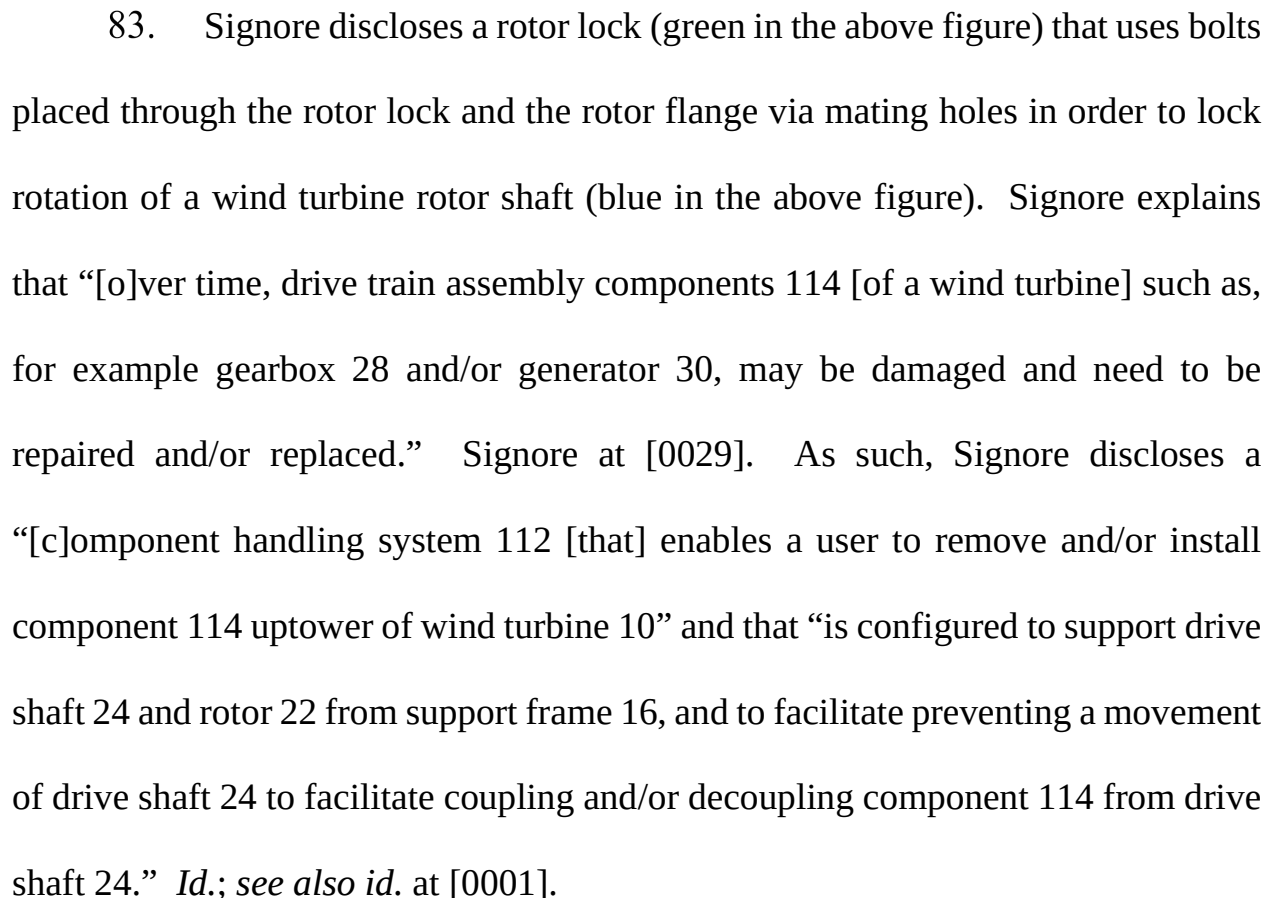
81. In this section, I provide an overview of the 10 prior art references relied upon in the obviousness combinations detailed in Grounds 1-3. In addition, as discussed below, the ’518 Patent is relied on as an anticipatory reference in Ground 4.¹⁹

¹⁹ In conducting prior art searches, I focused on short, key phrases relating to the patents (such as “uptower repair,” “main bearing replacement,” or “split bearings”) combined with one or two connecting terms (like “wind turbine” or “nacelle”). I ran date-limited searches primarily using Google and Google Patents. In addition, I ran some searches that included names of relevant companies (such as Cooper or

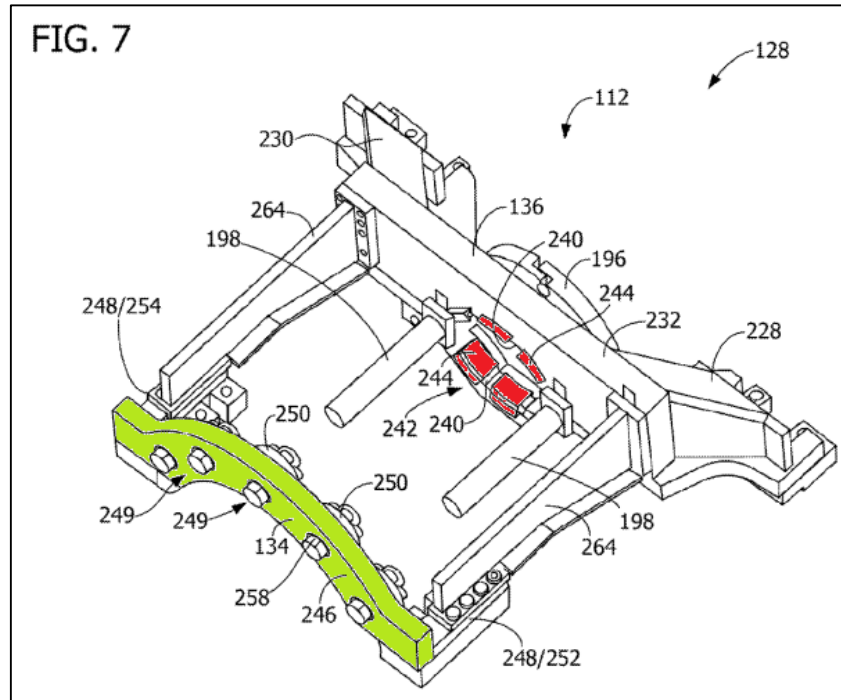
A. Signore

82. U.S. Patent Application Pub. No. US 2012/0141292 (the “’292 Application” or “Signore”) (Ex. 1007), titled “Component Handling System for Use in Wind Turbines and Methods of Positioning a Drive Train Component,” was published on June 7, 2012. The application that led to Signore, U.S. Patent Application No. 13/237,595, was filed on September 20, 2011. Signore is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

Schaeffler) or publications (such as WindTech) to help focus my searches. I also reviewed several old textbooks I own relating to wind energy. Finally, I reviewed references cited during prosecution of the ’578 Patent and related applications, and iteratively reviewed additional cited references of relevant art. Counsel for LiftWerx also provided prior art references for my review and consideration.



84. More specifically, Signore discloses a “shaft support assembly 128,” pictured in Signore Figure 7 below, that “includes a drive shaft locking assembly 134 [(green in the figure below)] and a restraint assembly 136. Shaft locking assembly 134 is adapted to be coupled to support frame 16 and to rotor locking member 74 to facilitate limiting a rotation of drive shaft 24 about drive shaft axis 66.” *Id.* at [0031]; *see also id.* at [0022] (describing the rotor locking member 74 on drive shaft 24 that mates with the drive shaft locking assembly 134).



85. In the exemplary embodiment of Signore, “a plurality of torque clamps 244 [(red in Signore Figure 7 above)] are coupled to interior surfaces 240, and are oriented circumferentially about opening 242. Each torque clamp 244 is configured

to facilitate coupling restraint assembly 136 to drive shaft 24 via a friction fit to facilitate limiting a movement of the drive shaft 24.” *Id.* at [0053].

86. In addition, the “[s]haft locking assembly 134 [(green in Signore Figure 7 above)] is adapted to be coupled to support frame 16 and to rotor locking member 74 to facilitate limiting a rotation of drive shaft 24 about drive shaft axis 66,” and “restraint assembly 136 is adapted to be coupled to support frame 16 and to drive shaft 24 to facilitate limiting an upward movement of drive shaft 24.” *Id.* at [0031].

87. Finally, Signore discloses use of a “lifting device 116 ... such as ... a gantry crane positioned within nacelle 18 ... to facilitate coupling and/or decoupling component 114 [such as a gearbox] from drive shaft 24. *Id.* at [0027].

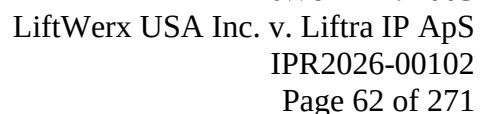
B. Weaver

88. European Patent No. 1,748,182 (the “’182 Patent” or “Weaver”) (Ex. 1008), titled “Method and apparatus for replacing a gearbox in a wind turbine,” was issued and published on June 11, 2013. The application that led to Weaver, European Patent Application No. 06253865.7, was filed on July 24, 2006, and itself claims priority to U.S. Patent Application No. 11/190,761, filed on July 27, 2005 and issued as U.S. Patent No. 7,721,434. Weaver is prior art under at least AIA 35 U.S.C. § 102(a)(1).

89. Weaver discloses “methods and apparatus that assist in the removal [and] replacement of gearboxes in wind turbine generators without requiring the

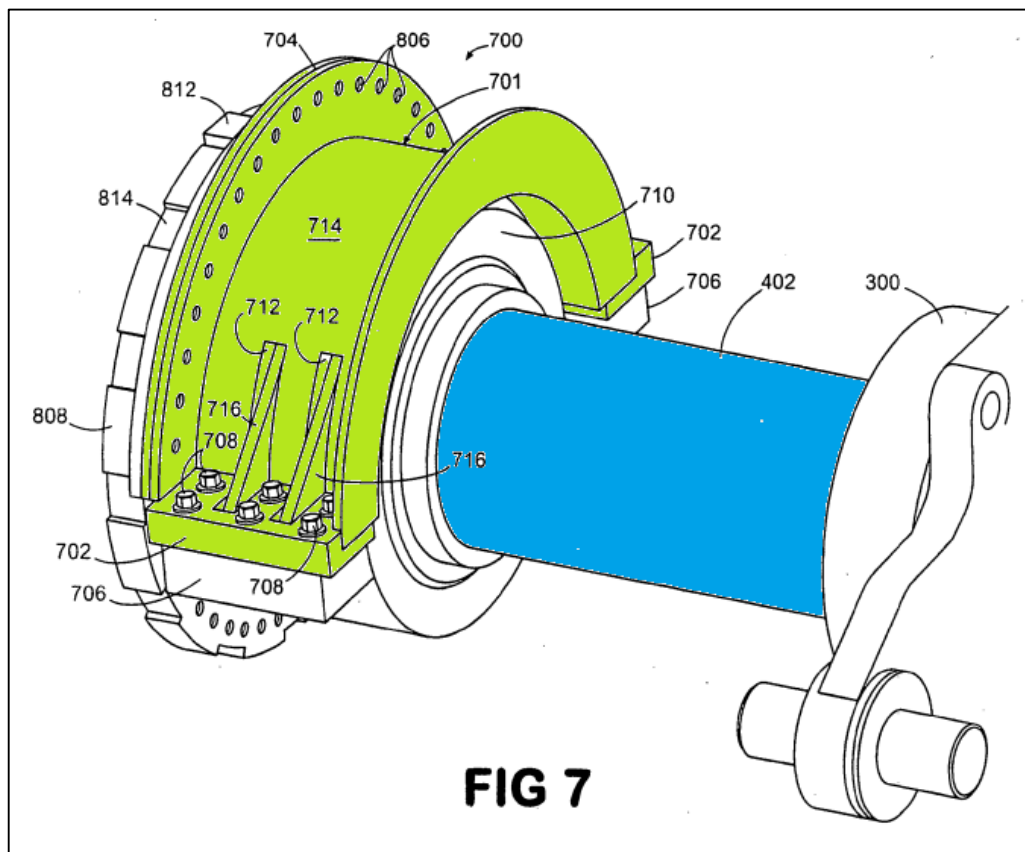
removal of blades from the wind turbine generator.” Weaver, [0001]. Weaver discloses a wind turbine shaft restraining member (400) that is lifted into place and placed on top of the wind turbine’s rotor shaft. *See* Weaver, [0015]. Hydraulically or mechanically operated friction brakes (518) in the restraining member clamp the main shaft (402) and prevent it from rotating. *See* Weaver, [0016]-[0017].

90. More specifically, Weaver discloses a shaft-restraining member “that is used to restrain rotating shaft 402 ... from tilting from its horizontal position when gearbox 300 is removed from wind turbine 100 without the removal of rotor 104.” *Id.* at [0015]. In an additional configuration, Weaver’s shaft-restraining member 400 “include[s] under support members 500 that are mounted under main shaft 402,” and “[h]alf-spool member 401 and under support members 500 are configured in some configurations of the present invention to also inhibit rotation of shaft 402 due to wind on rotor 104 during at least a time before gearbox 300 is removed until after a replacement gearbox re-anchors shaft 402 in place.” *Id.*



LiftWerx Ex. 1003

92. In addition, Weaver also discloses a rotor lock that employs bolts placed through the rotor lock and the rotor flange via mating holes in order to lock rotation of the rotor shaft. *Id.* at [0011]. Weaver discloses that the rotor lock is used to “assist in the removal replacement of gearboxes in wind turbine generators without requiring the removal of blades from the wind turbine generator.” *See id.* at [0001].



93. More specifically, Weaver discloses that “[b]y fastening semi-annular member 704 to mounting flange 806, half-spool member 701 to semi-annular member 704, and half-spool member 701 to mounting flanges 706 or to bolts 708 therein [(704 and 701 green in Weaver Figure 7 above)], shaft 402 [(blue in Weaver

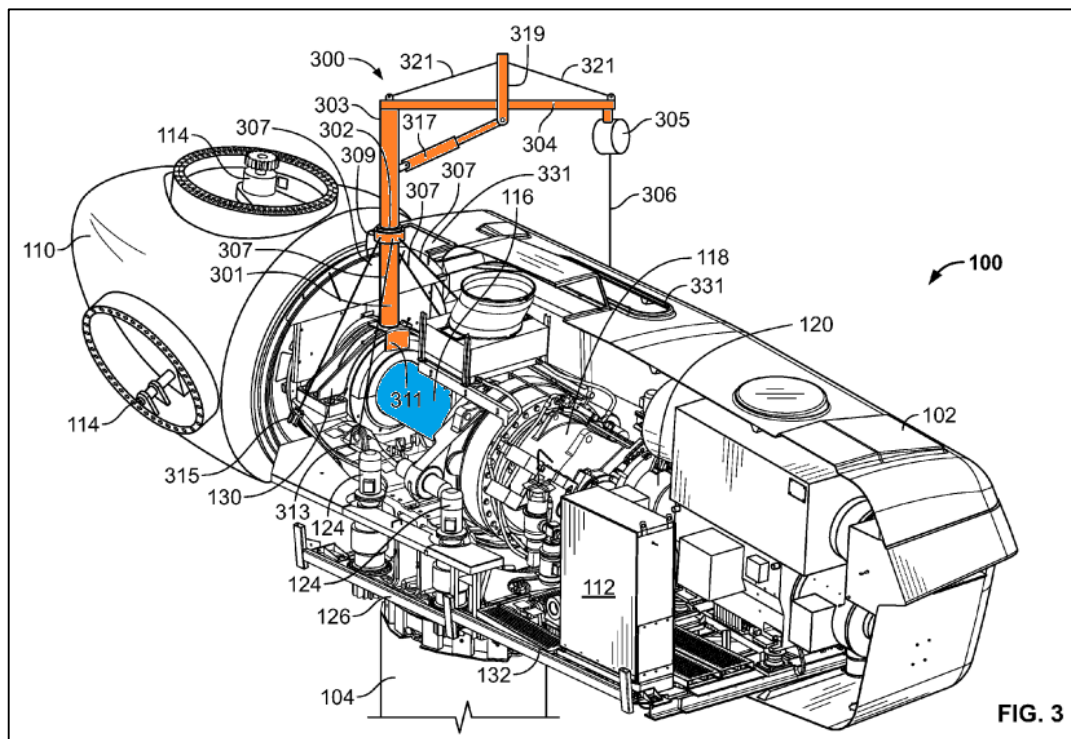
Figure 7 above)] is effectively restrained from tilting and its rotation effectively inhibited. Gearbox 300 can then be safely removed and replaced.” *Id.* at [0023]. Weaver also discloses additional embodiments of rotor locks. *See, e.g., id.* at [0020] (disclosing a rotor lock with a “differently configured half-spool member 701 having mounting ears or flanges 702 and a semi-annular member 704”), [0022] (disclosing a rotor lock in which “half-spool member 701 is placed over main shaft 402, and more particularly over journal or bearing 710”), [0024] (disclosing a rotor lock with “one or more axially extending protuberances 812 such as a tooth, a key, or a wedge” on “semi-annular member 704” to “engage[] an appropriately shaped gap 814 in a circumference of mounting flange 808 to effectively inhibit rotation of shaft 402”).

94. Finally, Weaver discloses that “[i]n some configurations, shaft-restraining members 400 are configured to allow for rotation of rotor 104 during high wind speed events that may occur during replacement of gearbox 300 to prevent damage to wind turbine 100 or the danger of heavy components that might shear off in such conditions.” *Id.* at [0018]. Weaver teaches allowing limited rotation by replacing the friction brakes such that “surfaces 520 are Teflon(TM)-covered or provided with roller bearing surfaces in some configurations that allow rotation of shaft 402 above a predetermined torque.” *Id.*

C. Stegemann

95. U.S. Patent Application Pub. No. 2010/0021278 (the “’278 Publication” or “Stegemann”) (Ex. 1009), titled “Portable Crane System for Wind Turbine Components,” was published on January 28, 2010. The application that led to Stegemann, U.S. Patent Application No. 12/256,499, was filed on October 23, 2008. Stegemann is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

96. Stegemann discloses a lightweight crane mounted to a wind turbine component.

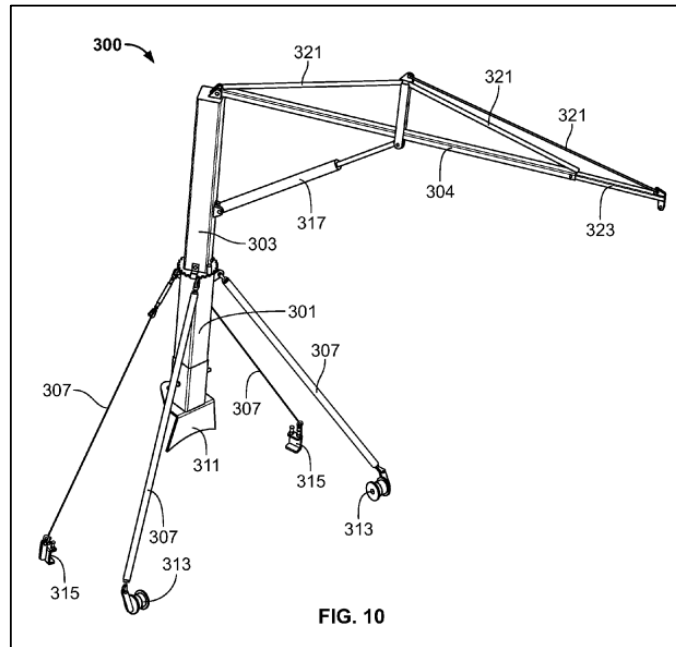


97. Stegemann discloses a crane assembly 300 (orange in Stegemann Figure 3 above). Stegemann also discloses that “[t]he individual components of the first crane assembly 300 ... preferably do not exceed about 30 kg and are sufficiently

lightweight and sufficiently small to be handled manually. More specifically, the components of the first crane assembly 300 ... would be sufficiently disassemblable to permit the individual components to be carried by hand.” Stegemann at [0046].

98. In addition, Stegemann discloses that “[t]he first primary support member 301 is attached to the wind turbine by attachment plate 311,” which is “configured to mate, attach or otherwise fasten to a component of the wind turbine 100.” *Id.* at [0039]. Further, Stegemann discloses that “[w]hile not so limited, the attachment plate 311 may attach to or replace existing components, and utilize existing fastening locations.” *Id.*

99. In addition, Stegemann discloses additional, “secondary support members 307 [which] may be a bar, wire, cable, rope, chain, strap or any other elongated device capable of supporting the first and second primary support members 301, 303.” *Id.* at [0040]. Such secondary support members may be anchored to “secondary support clamps 315 [which] may be clamped or otherwise fastened to *lips, features or surfaces within the wind turbine 100 that provide a desired angle providing support for the first and second primary support members 301, 303.*” *Id.*

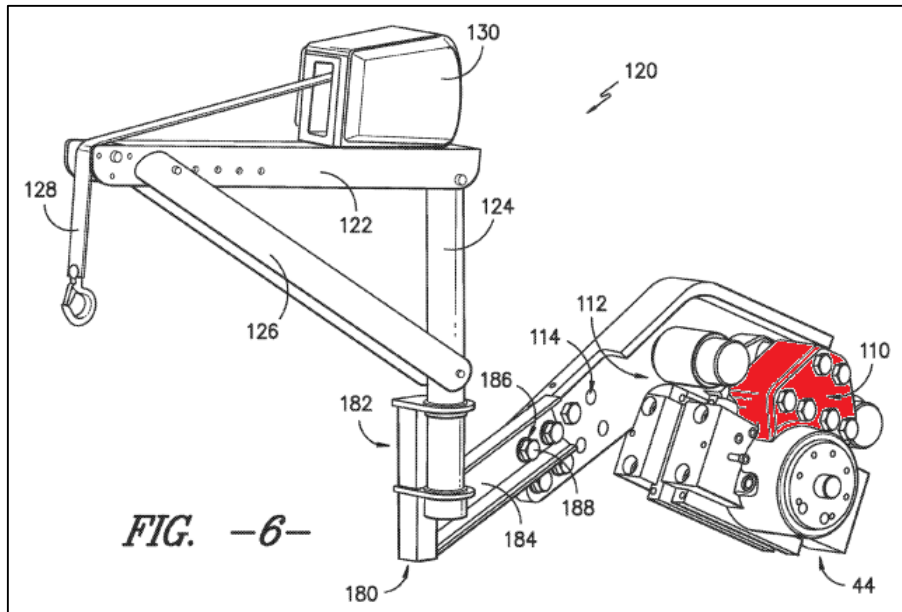


D. Holloway

100. U.S. Patent No. 9,651,020 (the “’020 Patent” or “Holloway”) (Ex. 1010), titled “Portable Crane for Use in Wind Turbines,” was issued on May 16, 2017. The application that led to Holloway, U.S. Patent Application No. 14/034,763, was filed on September 24, 2013. Holloway is prior art under at least AIA 35 U.S.C. § 102(a)(2).

101. Holloway discloses mounting a portable crane to various areas or parts of a wind turbine, including to the bedplate of the nacelle or to a brake caliper used to arrest the rotor. In particular, Holloway discloses “[a] portable crane for a wind turbine, the crane comprising...a plurality of interchangeable mount assemblies...mountable to a wind turbine component...,” “mountable to a lift eye of

the bedplate,” or “mountable to a brake caliper of the gearbox.” Holloway at Claims
1, 6, 9.



102. More specifically, and with regard to Holloway’s brake caliper-mount embodiment, Holloway discloses “a mount assembly 180 for use with a brake caliper 110 [(red in Holloway Figure 6 above)] of a gearbox 44” *Id.* at 7:3-4. In the brake caliper-mount embodiment, “[s]upport shaft 124 [of the crane] may be rotatably mounted” via hinge portion 182, a flange 184, “which may abut again flange 112 of the brake caliper 110.” *Id.* at 7:5-9. Fasteners, such as bolts, then “couple[e] the flange 184 and mount assembly 180 in general to the brake caliper 110....” *Id.* at 7:9-13. Holloway discloses that the possible mount assemblies are not limited to these embodiments, and that “mount assemblies may be utilized to detachably mount the crane 120 to various other suitable wind turbine 10

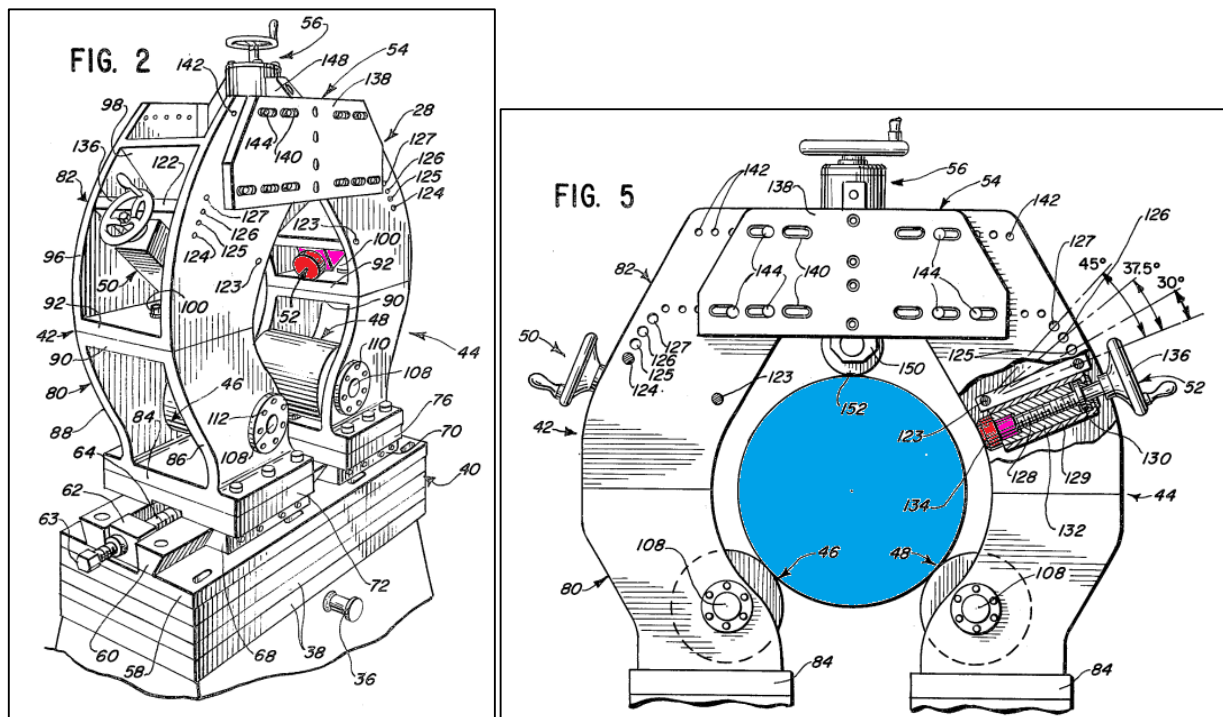
components. For example, the crane 120 may be mounted through use of a suitable mount assembly to... the main shaft 40, a main bearing, etc.” *Id.* at 7:20-32. Holloway further discloses that “[a]ttachment of any of the various suitable mount assemblies through, for example, suitable bolting, clamping, or other mounting techniques are within the scope and spirit of the present disclosure.” *Id.* at 7:36-39. Holloway further discloses that the mount assembly “may further include a mount assembly that can be modified for use in mounting a crane 120 to two different wind turbine 10 components, or any other suitable mounting means.” *Id.* at 7:40-48.

103. Once mounted, “[t]he hinge portion 182 ... allow[s] rotation of the support shaft 124 about a central longitudinal axis, facilitating movement of the support shaft 124 and other crane 120 components. Thus, the crane 120 may be utilized to move heavy components inside the nacelle 16, such to various locations around the gearbox 44.” *Id.* at 7:3-19.

E. Schulz

104. U.S. Patent No. 4,177,701 (the “’701 Patent” or “Schulz”) (Ex. 1013), titled “Steady Rest for Use in Apparatus for Supporting and Precision-Turning of Large Rotary Devices,” was issued and published on December 11, 1979. The application that led to Schulz, U.S. Patent Application No. 939,322, was filed on September 5, 1978. Schulz is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

105. Schulz discloses a shaft fixture for heavy rotor shafts used in transferring power to a power generation turbine, in particular rotor shafts (blue in Schulz Figure 5 below) for steam turbine electric generators, which “may weigh as much as 150 tons, and may be 35 feet long.” Schulz at 1:11-12. The shaft fixture of Schulz is used to make repairs, *id.* at 1:8-17, and would also be considered suitable for fixation of a main shaft on a wind turbine. Because wind turbines are power generation equipment with heavy shafts, similar to the large, heavy shaft described by Schulz, when in-situ repairs must be made it is necessary to support and position the wind turbine shaft accurately as described by Schulz. Schulz describes the need to “support the turbine shaft securely in a given attitude.” *Id.* at 1:29-35.



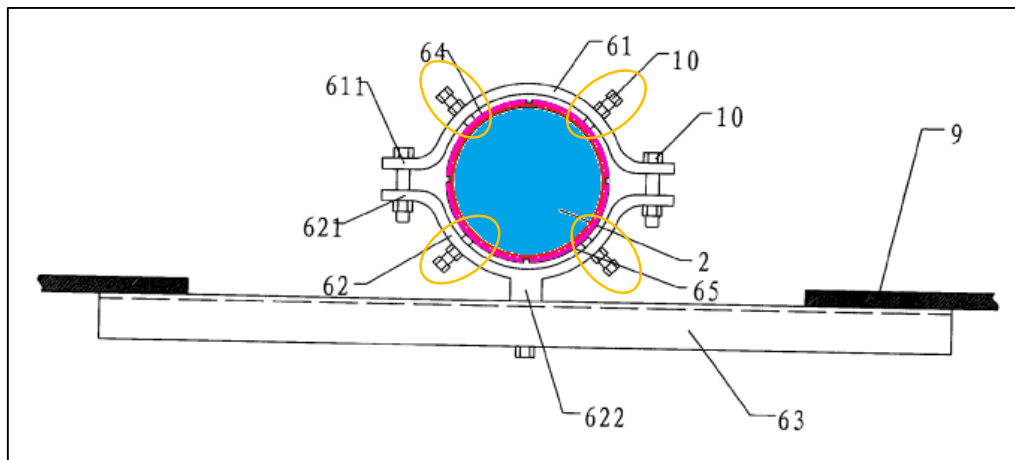
106. More particularly, Schulz discloses a “head” with radially displaceable pressure mandrels with brake pads. *Id.* at 3:6-14. Schulz discloses “[b]rakes 50 and 52 [which] are identical [in] their construction.” *Id.* at 4:28. For example, “[b]rake 52 includes a brake plate 122, which is connected to a brake pivot pin 123 ... [and] may be angularly adjusted by securing [the other] end of the brake plate at a selected aperture[s] [124-127].” *Id.* at 4:28-36. In addition, “[a] brake housing 128 is secured to brake plate 122. The housing has a brake screw 129 rotatably mounted therein, which brake screw has a brake screw collar 130 secu[r]ed thereto in rotatable engagement with the housing and thereby retainingly holding the brake screw. An elongated brake nut 132 is threadedly mounted on the brake screw. The brake nut has a brake pad 134 [(red in Schulz Figures 2 and 5 above)] mounted on the end of the nut [(pink in Schulz Figures 2 and 5 above)].” *Id.* at 4:39-47. In order to operate the brakes to secure the rotor shaft, “[a] conventional wheel 136 is fixed to the brake screw to provide a convenient means for turning the screw for extension or retraction of the brake pad 134....” *Id.* at 47-52. Schulz describes a vertical adjustment assembly 26 to allow the vertical position of the shaft to be raised and lowered. *Id.* at 2:56-3:5. Schulz also teaches a device that allows a shaft to be fixed in location but allowed to rotate, or alternatively held against rotation by brakes during certain operations. *Id.* at 5:64-6:1.

F. Hanxing

107. China Patent Application No. 201483408 (the “408 Application” or “Hanxing”) (Ex. 1014), titled “Special Fixture for Replacing Gearbox of Single-Support Main Shaft Wind Turbine Set,” was filed on October 13, 2009 and published on May 26, 2010. Hanxing is prior art under at least AIA 35 U.S.C. § 102(a)(1).

108. Hanxing discloses a “device for assembling or disassembling the gearbox of a wind turbine, specifically to a special fixture for replacing the gearbox of a single-support main shaft wind turbine set.” See Hanxing at [0001].²⁰

109. Hanxing discloses a clamp used for replacing a gearbox of a wind turbine with a single supporting main shaft.



Hanxing at Figure 4 (annotated).

²⁰ All citations to Hanxing are to a certified translation of Hanxing, which is included in Exhibit 1014. Ex. 1014 at 13 of 31.

110. More specifically, Hanxing discloses a rotor clamp comprising “upper clamping hoop 61, lower clamping hoop 62, and anti-rotation plate 63. The upper and lower clamping hoops 61/62 encircle the main shaft 2 [blue in Hanxing Figure 4 above] and are securely fastened together to tightly hold the main shaft 2,” and that “the middle [is] connected to the lower clamping hoop 62.” See Hanxing at [0029].

111. In order to adapt to the rotor shaft, Hanxing discloses “two arc-shaped steel plates 64 [pink in Hanxing Figure 4 above] can be installed inside each of the upper clamping hoop 61 and the lower clamping hoop 62, forming a steel sleeve with four steel plates 64” around the rotor shaft. *Id.* at [0031]. Hanxing further discloses that “a layer of soft wear-resistant material 65,” (red in Hanxing Figure 4 above), *e.g.*, a brake pad, “can also be added inside the steel sleeve for better sealing.” *Id.*

112. Finally, Hanxing discloses that “[m]ore than two screw holes are provided on the upper and lower clamping hoops 61/62, and bolts 10 [circled in orange in Hanxing Figure 4 above] passing through these screw holes will tightly press the steel sleeve against the main shaft 2 to ensure surface contact.” *Id.* at [0031]. The adjustable bolts 10 engaging four steel plates are radial displaceable and substantially symmetrical, being located around the center axis of the main shaft. The bolts 10 are displaceable between a passive position where sleeve 64 is located

at a distance from a surface of the main shaft and an active position where the sleeve 64 is configured to be engaged with the main shaft 2.

G. Cooper

113. The “US Value Proposition” document from Cooper Roller Bearings Company Limited (Ex. 1019), available at <https://web.archive.org/web/20130531010830/http://www.cooperbearings.com/downloads/English/Value%20Proposition.pdf> (WayBack Machine capture from May 31, 2013), was published at least as early as May 31, 2013,²¹ and is prior art under at least AIA 35 U.S.C. § 102(a)(1). A POSITA as of the priority date of the ’578

²¹ Cooper lists an issue date of “June 2010” and has metadata reflecting that it was created and last modified on July 14, 2010. Further, it can be found at the WayBack Machine capture link above, which is from May 31, 2013. A substantially identical, but higher quality, version with an issue date of “March 2011” and metadata reflecting it was created and last modified on March 22, 2011 can be found at <https://www.cooperbearings.com/downloads/USA/US%20Value%20Proposition.pdf>. Ex. 1035. A screenshot showing the metadata of these documents before they were processed for IPR submission (*i.e.*, with stamping, which updated the “Last Modified” date) is appended to each exhibit. Ex. 1019 at 3 of 3; Ex. 1035 at 7 of 7.

Patent would have been familiar with Cooper roller bearings, as they were a well-known manufacturer of bearings for wind turbines and it was common in 2014 for wind energy engineers to refer to catalogs and other sales materials from Cooper to aid them in selecting bearings for wind energy applications, considering that Cooper was a major supply chain partner to the wind energy industry. Cooper appears on the “Downloads” page of the Cooper Roller Bearings Company Limited website and is titled “Value Proposition” (see <https://web.archive.org/web/20130604063425/https://www.cooperbearings.com/downloads.asp> (WayBack Machine Capture from June 4, 2013)), which would have been of interest to a POSITA seeking more cost efficient means of uptower wind turbine repair. Further, Cooper is a customer-facing document and lists contact information for customer service centers all over the world, including in Norfolk, VA. Cooper at 1 of 3.

114. Cooper discloses a suite of split roller bearings, which include “Made to Order Services for specific engineering solutions....” Cooper at 2 of 3. The split roller bearings disclosed by Cooper include split roller bearings mounted on “pillow blocks,” *id.* at 2 of 3, and that are intended for use in “Power Generation,” including in “Wind Turbines.” *Id.* at 2 of 3.



H. Schaeffler

115. The “Split spherical roller bearings” document from Schaeffler Technologies GmbH & Co. KG (“Schaeffler”) (Ex. 1020), available at https://web.archive.org/web/20130615221441/https://www.schaeffler.com/remotemedien/media/_shared_media/08_media_library/01_publications/schaeffler_2/public

[ation/downloads_18/wl_43165_de_en.pdf](#) (WayBack Machine capture from June 15, 2013), was published at least as early as June 15, 2013.²² Schaeffler is prior art under at least AIA 35 U.S.C. § 102(a)(1). A POSITA as of the priority date of the '578 Patent would have been familiar with Schaeffler roller bearings, as they were a well-known manufacturer of bearings for wind turbines and it was common in 2014

²² Schaeffler states that it was “[i]ssued” in November 2011. Schaeffler at 28 of 29. Further, it can be found at the WayBack Machine capture link above, which is from June 15, 2013. Schaeffler has metadata reflecting that it was created on November 15, 2011 and last modified on November 23, 2011. A screenshot showing the metadata of Schaeffler before it was processed for IPR submission (*i.e.*, with stamping, which updated the “Last Modified” date) is appended to Exhibit 1020. Ex. 1020 at 29 of 29. The WayBack Machine capture is of the URL:

https://www.schaeffler.com/remotemedien/media/shared_media/08_media_library/01_publications/schaeffler_2/publication/downloads_18/wl_43165_de_en.pdf.

This URL is the first hit in a date-limited Google search (prior to October 7, 2014) for “Schaeffler split roller bearing” (Ex. 1042) and the second webpage hit for “split roller bearing” (Ex. 1041). A POSITA interested in a multi-part bearing for a wind turbine would know that the term “split bearing” would also yield relevant results.

for wind energy engineers to refer to catalogs and other sales materials from Schaeffler to aid them in selecting bearings for wind energy applications, considering that Schaeffler was a major supply chain partner to the wind energy industry. Schaeffler is a customer-facing document. For example, it states “[o]ther designs are also available; please contact us” and provides contact information (including a website, e-mail, and phone numbers). Ex. 1020 at 10 of 29, 28 of 29.

116. Schaeffler discloses split spherical roller bearings that offer “[c]ost[] savings through rapid bearing replacement at difficult to access bearing locations.” Schaeffler at 1 of 29. Schaeffler discusses that “[s]plit spherical roller bearings are principally used where the replacement of unsplit spherical roller bearings would require costly additional work, involving the removal of gears or couplings, the dismounting of drives or the dismantling of shaft power trains. The use of split spherical roller bearings reduces the downtime of machinery and plant.” *Id.* at 4 of 29.



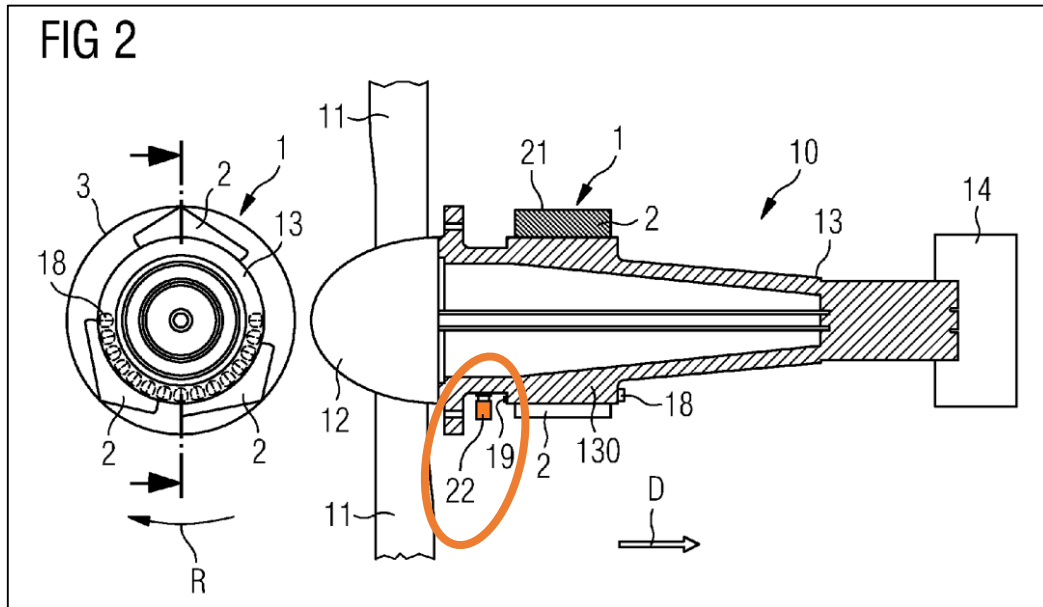
117. Schaeffler further discloses a general procedure for the fitting of a split spherical roller bearing. *See id.* at 9 of 29. The process described includes “[s]upport[ing] the weight of the rotor” (*e.g.*, raising the end of the rotor shaft to create clearance for the bearing replacement process), “[d]ismount[ing] the old bearing” (including “cut[ting] through” the “unsplit bearing” to be replaced), “[p]lac[ing] the outer ring half [of the split roller bearing] in the lower section of the housing and align[ing] it with the inner ring mounted on the shaft, then screw[ing] together the inner ring halves,” “[f]it[ing] the remaining parts,” and “[l]ower[ing] **the shaft** in order to subject the bearing to load.” *Id.* A video entitled “Schaeffler Split Spherical Bearings” showing an animated version of the Schaeffler procedure was uploaded to www.youtube.com on April 8, 2014 by user “Kaman Distribution” (“Schaeffler Video”) (Ex. 1021) (available at <https://www.youtube.com/watch?v=KsLRz2oaBz4>). The video is the second hit on

Google (date limited to before 10/7/2014) and the third hit on YouTube when running a search for “Schaeffler split roller bearing.” Exs. 1042, 1043. It is the third video hit on Google (date limited to before 10/7/2014) when running a search for “split roller bearing.” Ex. 1041. The Schaeffler Video corroborates the disclosure of Schaeffler, as the shaft can be seen being raised starting around 00:17 and lowered starting around 00:46. *See* Ex. 1021 at 18-25, 47-52 of 124.

I. Guerenbourg

118. U.S. Patent Publication No. 2012/0099993 (the “’993 Publication” or “Guerenbourg”) (Ex. 1022), titled “Wind Turbine Main Bearing,” was published on April 26, 2012. The application that led to Guerenbourg, U.S. Patent Application No. 13/380,116 claims priority to provisional application No. 61/244,525, filed on July 10, 2009. Guerenbourg is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

119. Guerenbourg recognizes that “[t]ypical service issues” for wind turbines “are the replacement of defective bearings, particularly the main bearing, which must support very high dynamic loads depending on wind turbine size and wind conditions.” Guerenbourg at [0004]. Guerenbourg further recognizes that “the lifetime and performance of the bearing is becoming a more critical aspect in wind turbine design....” *Id.* at [0005]. As such, Guerenbourg discloses “a method of performing maintenance on a wind turbine....” *Id.* at Abstract.



120. More specifically, Guerenbourg discloses a wind turbine fluid main bearing, and methods for servicing wind turbine fluid main bearings “without having to disassemble the drive train...” *Id.* at [0013]. The “method of performing maintenance on such a wind turbine” of Guerenbourg “comprises the steps of halting a rotation of the shaft, **operating a lifting arrangement to raise the shaft**, and removing a bearing pad of the wind turbine main bearing from a bearing housing of the wind turbine main bearing,” which Guerenbourg describes as a “very straightforward method.” *Id.* at [0017]. Guerenbourg further discloses “**a lifting arrangement such as a jack** [(orange in Guerenbourg Figure 2 above)] **for raising a relevant part such as the main shaft** to reduce the load on the main bearing in order to facilitate removal, insertion or maintenance of a bearing pad in the lower region of the bearing housing.” *Id.* at [0032]; *see also id.* at [0053] (“[A] jack 22 is

mounted on the Nacelle bedplate, and can be used to raise the main shaft 13 by a sufficient amount to allow one of the lower bearing pads 2 to be removed.”). Guerenbourg describes this lifting arrangement, for example, as “a simple jack, [which,] as the skilled person will appreciate, is quite easily installed in a wind turbine Nacelle housing.” *Id.* at [0032]. Guerenbourg further explains that “[u]sing such a jack, the main shaft or rotor can be lifted and fixed to support the load and hold the shaft stable. Then, since the bearing pads are no longer under any load, they can easily be replaced in one operation.” *Id.*

J. Power Climber

121. The January 22, 2014 press release by Power Climber Wind²³ (“Power Climber”) (Ex. 1023), describes the provision of “over 1,000 [Power Climber Wind] nacelle davits to 18 different wind plants across North America.” Power Climber is prior art under at least AIA 35 U.S.C. § 102(a)(1) because it is a printed publication accessible to the public no later than January 22, 2014.²⁴

²³ The Power Climber press release describes Power Climber Wind as a division of SafeWorks LLC.

²⁴ Power Climber has metadata reflecting that it was created and last modified on January 22, 2014. A screenshot showing the metadata of Power Climber before it

122. The public availability of Power Climber is corroborated by a January 23, 2014 article in WindTech International titled “Power Climber Wind supplies over 1,000 nacelle davits in North America.” *See* Ex. 1024 (“WindTech Publication”), *available* *at* <https://web.archive.org/web/20140130072352/http://www.windtech-international.com:80/products-news/power-climber-wind-supplies-over-1-000-nacelle-davits-in-north-america> (WayBack Machine capture from January 30, 2014). The public availability of Power Climber is further corroborated by the press release’s directing the public to “download the brochure at <http://www.powerclimberwind.com/NacelleDavit.aspx>.” Ex. 1023. The provided link leads to a Nacelle Davit website that describes the Power Climber Wind Nacelle Davit and directs users to “Download” the Power Climber Brochure. The Power Climber Wind Nacelle Davit Brochure available at the download link (“Power Climber Brochure”) (Ex. 1027) was created by no later than August 8, 2012. *See* Ex. 1027.²⁵ The metadata along with the fact that Power Climber was publicly

was processed for IPR submission (*i.e.*, with stamping, which updated the “Last Modified” date) is appended to Exhibit 1023. Ex. 1023 at 2 of 2.

²⁵ The metadata reflects the document was created and last modified on August 8, 2012. A screenshot showing the metadata of the Power Climber Brochure before it

accessible by no later than January 22, 2014 and directed users to the Power Climber Brochure is strong evidence that the Power Climber Brochure was also publicly accessible by no later than January 22, 2014.

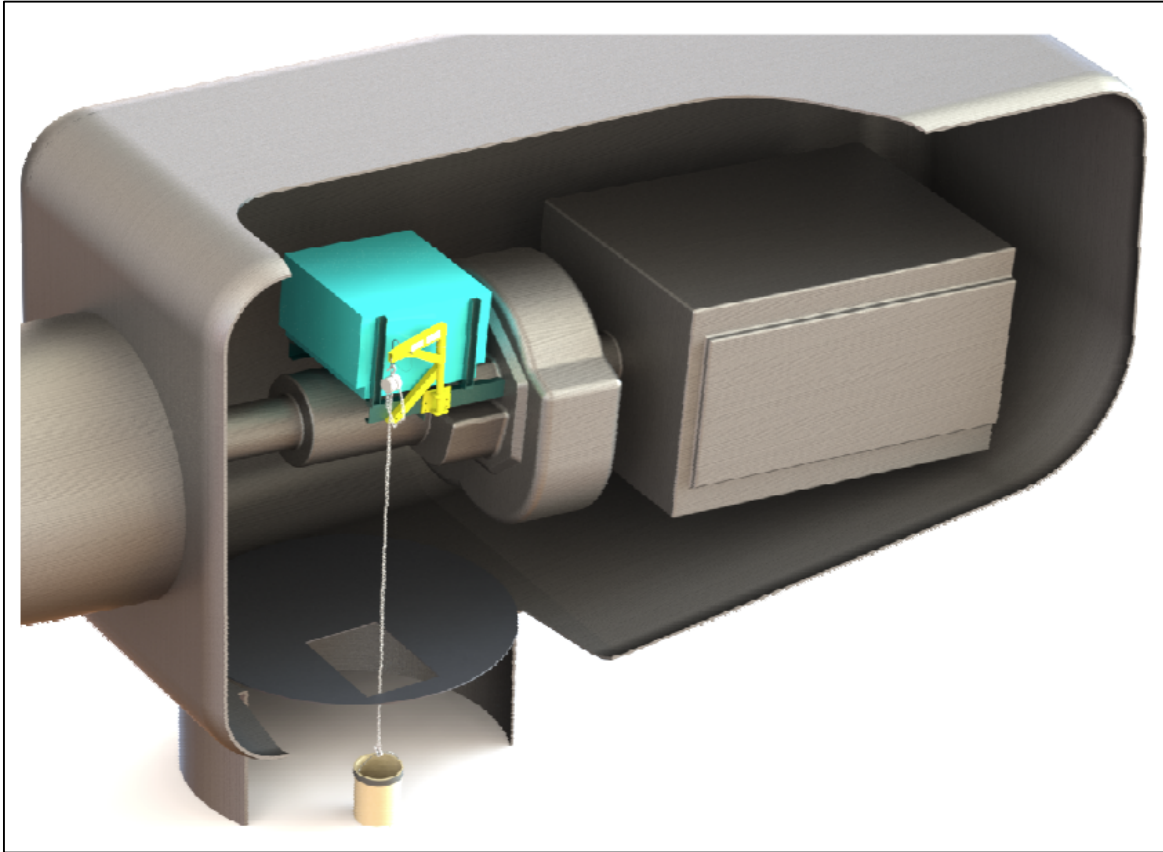
123. “Windtech International is the only worldwide magazine, website and newsletter for the wind energy industry with a clear focus on technology and is the ideal forum for the promotion and explanation of products, techniques and applications” and “has been published for more than 20 years.” Ex. 1026 (available at <https://www.windtech-international.com/advertising/advertising-information>).

The WindTech International website is described as “attract[ing] more than 210,000 visitors and 1,200,000 page views per month.” *Id.* A POSITA would understand that in 2014, WindTech International was among the most reputable and popular sources of technical information related to commercial aspects of the wind energy industry. In 2014, there were academic journals that published scholarly articles related to wind energy, and there were magazines dedicated to primarily commercial and policy-related articles such as Windpower Monthly, but for information related to technology actually deployed in the commercial wind energy industry, WindTech International was among the best known and most useful publications (both the print

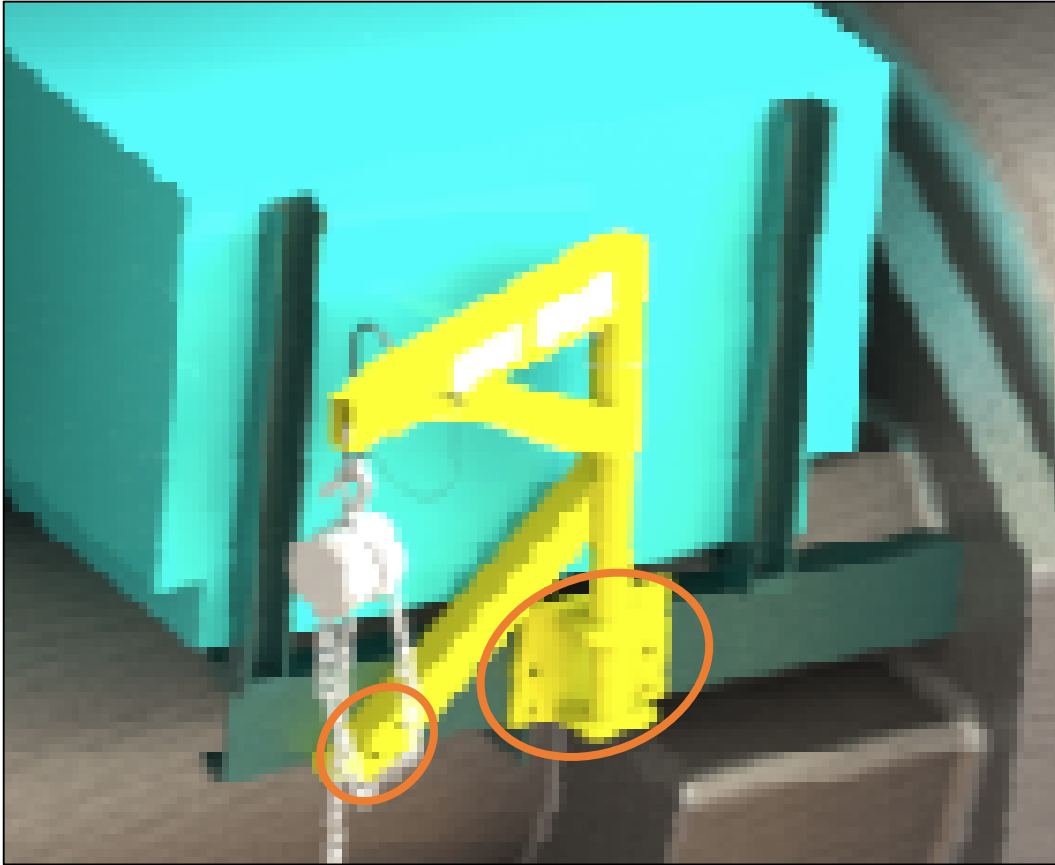
was processed for IPR submission (*i.e.*, with stamping, which updated the “Last Modified” date) is appended to Exhibit 1027. Ex. 1027 at 3 of 3.

version and the website). Material from WindTech International was available to professionals in the wind energy industry for free in both print format and electronic format at no cost, and the magazine could be found in many library collections in 2014. A POSITA would have accessed Power Climber and the WindTech Publication if interested in information about the wind turbine industry, including uptower repair. Power Climber is prior art under at least AIA 35 U.S.C. §§ 102(a)(1).

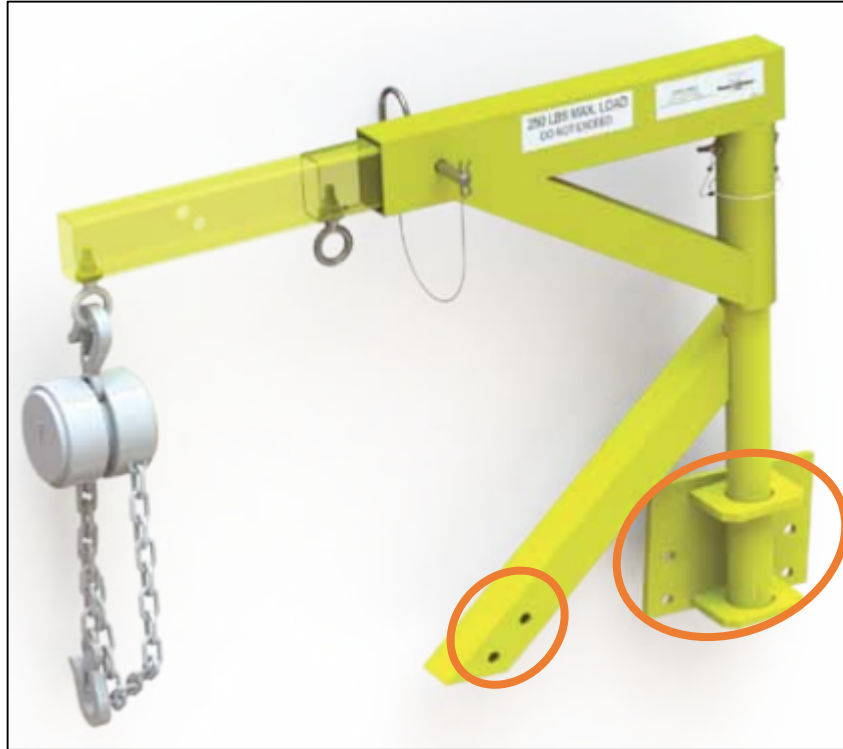
124. Power Climber discloses a lightweight Nacelle Davit lifting device (crane) that “has the ability to retrofit to any 1.5 MW gearbox, and installs in just under an hour” and features “a 250-lb capacity and optional chain or electric hoist.” *See* Ex. 1023. In addition, Power Climber depicts the Power Climber Wind Nacelle Davit (yellow) mounted to a structure (green) that appears to be analogous to a main shaft fixture in a wind turbine. In addition, the green structure depicted in Power Climber is mounted in close proximity to a main shaft of the depicted wind turbine, and would appear to a POSITA to be analogous in terms of structure and location to the main shaft fixtures taught by Signore and Weaver, as well as the fixture described and claimed in the ’578 Patent. For these reasons, the green structure depicted in Power Climber is referred to herein as a “main shaft fixture.”



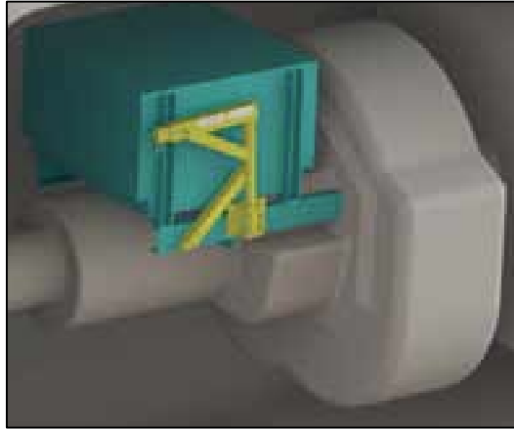
125. The figure in Power Climber depicts the Nacelle Davit mounted to the main shaft fixture via a mounting plate with holes, *e.g.*, for mounting bolts. For example, the mounting plate of the Nacelle Davit can be clearly seen in an enlarged view of Power Climber's figure:



126. The disclosure of the mounting facilities on the main shaft fixture / Nacelle Davit is corroborated by the August 8, 2012 Power Climber Brochure (Ex. 1027). The Power Climber Brochure discloses that the Nacelle Davit is configured to be mounted on a main shaft fixture of a “any GE 1.5 turbine nacelle.” See Ex. 1027. The Power Climber Brochure clearly depicts the mounting plate of the Nacelle Davit with holes, *e.g.*, for mounting bolts.



Further, the Power Climber Brochure discloses that the Power Climber Wind Nacelle Davit is “simple to install,” has a load capacity of 250 lbs., weighs just 37 lbs., and has a “[h]eaviest [s]ingle [p]iece that weighs just 19 lbs. *Id.* at 1, 2. In addition, the Power Climber Brochure corroborates Power Climber’s intended use of the Nacelle Davit, depicting the Power Climber Wind Nacelle Davit (yellow) mounted to a main shaft fixture (green) in a wind turbine.



K. The '518 Patent

127. As discussed in Section XII.D.1, *infra*, the '578 Patent's priority date is no earlier than January 24, 2024. As such, the '518 Patent, which was issued on August 13, 2019, qualifies as prior art under at least AIA 35 U.S.C. § 102(a)(1).

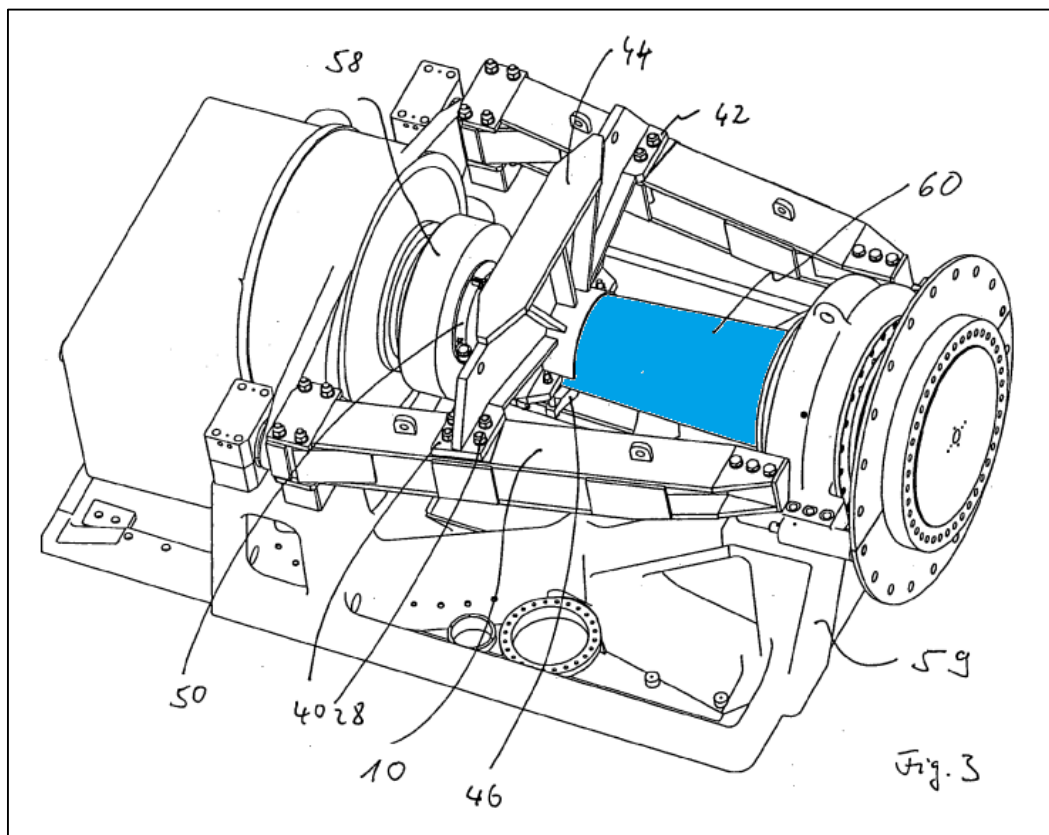
128. The specification of the '518 Patent is nearly identical to the specification of the '578 Patent, with only minor amendments to the '578 Patent's specification made in a preliminary amendment during the prosecution of the '578 Patent (including what appears to have been an attempt to **broaden** the scope of the specification). *See supra* Section VII.C, *infra* Section XII.D.1.

X. APPLICANT ADMITTED PRIOR ART

A. Tirdea

129. German Patent Application No. DE 10 2006 013 539 (the "'539 Application" or "Tirdea") was filed on March 24, 2006 and was published on September 27, 2007. Tirdea is applicant admitted prior art. *See* '578 Patent at 1:44-51. Tirdea is prior art under at least AIA 35 U.S.C. § 102(a)(1).

130. The Patent Owner admits that Tirdea “discloses a main shaft fixture for fixing the main shaft [(blue in Tirdea Figure 3 below)] on a wind turbine during the execution of installation and repair work on heavy parts that are arranged in the nacelle on wind turbines, with the fixture being divided up into a number of sections for installation on stable structural parts that are found on a wind turbine nacelle, including the bottom frame of the nacelle.” ’578 Patent at 1:44-51.



B. Self-Hoisting and Lightweight Cranes

131. Patent Owner admits that “the use of self-hoisting cranes, whose winches are placed on the ground surface near the turbine’s tower” was well known, and that “the use of such involves large savings in the level of expenses for servicing

Declaration of John Bosche in Support of Petition for
Inter Partes Review of U.S. Pat. No. 12,104,578
of wind turbines since the use of large mobile cranes for handling ... large and heavy
components is made superfluous.” ’578 Patent at 1:66-2:5. Further, Patent Owner
admits that the well-known use of self-hoisting cranes required “facilities for
anchoring the self-hoisting crane with the ground-based winch in the nacelle.” *Id.*
at 2:5-7. As such, self-hoisting cranes and facilities for anchoring the self-hoisting
crane with the ground-based winch in the nacelle are applicant admitted prior art.

132. Patent Owner further admits that the “self-hoisting winch requires ...
the presence of a lightweight crane, for the hoisting of snatch blocks, etc., that are to
be anchored on/in the nacelle or on the blades of the wind turbine,” and, therefore,
that “facilities for mounting the lightweight crane” were also required. *Id.* at 2:7-12.
As such, lightweight cranes anchored on/in the nacelle or on the blades of the wind
turbine and facilities for mounting such lightweight cranes are applicant admitted
prior art.

XI. BACKGROUND ART

133. The following is a description of background art discussed in the
grounds below that corroborates that various aspects of the Challenged Claims were
well known in the art by no later than October 7, 2014.

A. Boudreaux

134. U.S. Patent No. 4,464,127 (the “’127 Patent” or “Boudreaux”) (Ex.
1011), titled “Shaft Immobilizer Apparatus,” was issued and published on August 7,

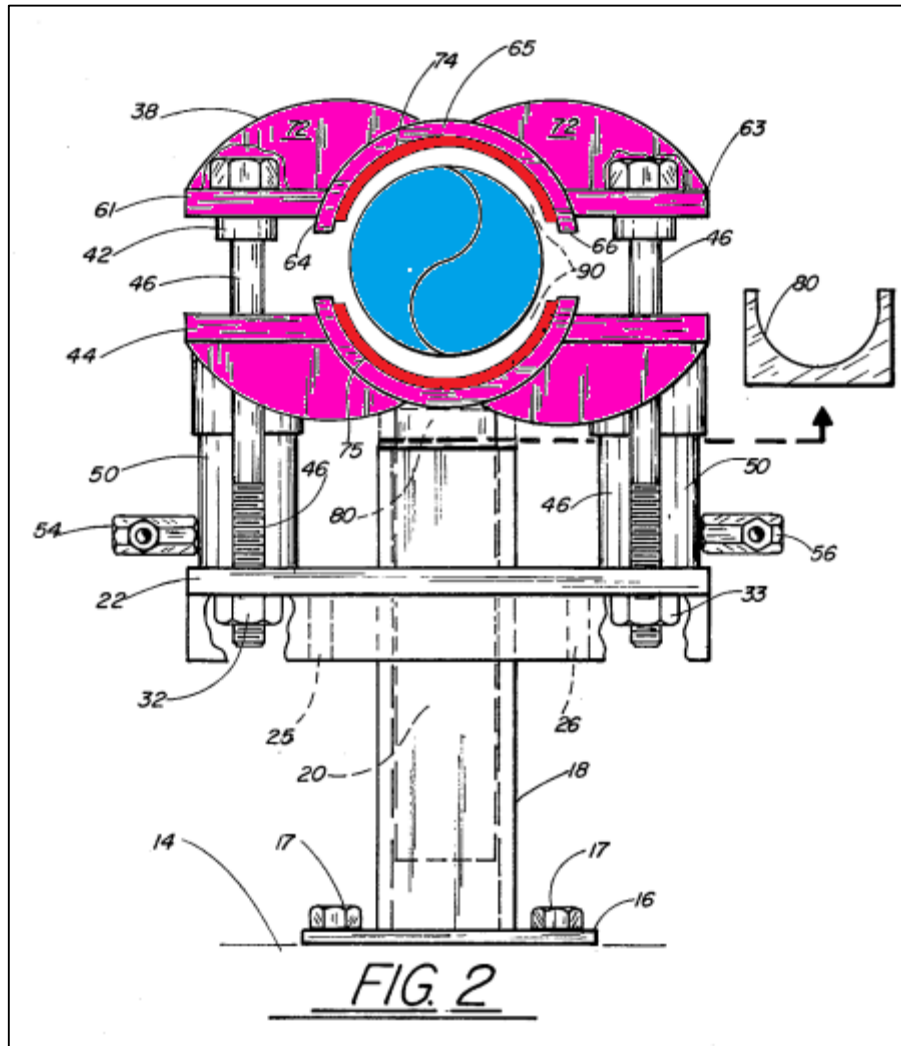
1984. The application that led to Boudreaux, U.S. Patent Application No. 366,550, was filed on April 8, 1982. Boudreaux is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

135. Boudreaux discloses a shaft immobilizer used in the energy industry, in particular “[i]n the use of large boats, particularly in crew boats, in servicing the offshore oil and gas industry.” Boudreaux at 1:5-14. More specifically, Boudreaux teaches “immobilizers for propeller shafts and the like” and “a propeller shaft immobilizer apparatus which hydraulically or manually immobilizes the propeller shaft,” which is particularly important “when [one of multiple engines] propelling the shaft becomes inoperative.” *Id.* at 1:6-11. Immobilizing the shaft is necessary in such circumstances because, as explained by Boudreaux, “the propeller beneath the craft, which is operated by the engine, remains exposed to the flow of current since the craft continues to be propelled by the remaining engines.” *Id.* at 1:20-23. In other words, the external forces of the flow of the water current act on “[a] screw-typed propeller, [which,] because of its vaned construction, continues to turn, ... rotating the shaft connected thereto.” *Id.* at 1:23-25. Such forces of the flow of the water current act on a screw-type propeller in much the same way that the flow of the air current acts on the blades on a wind turbine, which creates torque to rotate a shaft connected thereto. Further, because wind turbines are power generation equipment with heavy shafts, similar to the large, heavy shaft described by

Boudreaux, when in-situ repairs must be made, it may be desirable to immobilize the wind turbine shaft in a way similar to that described by Boudreaux, particularly since both the main shaft fixtures taught by Signore and Weaver are both directed, in part, to restraining a shaft against torque forces generated by fluid passing over a propellor.

FIG. 1

137. The propeller shaft immobilizer apparatus of Boudreaux includes a “vertically disposed lower base section mounted fixedly to the floor portion of a boat” and “an upper support base portion which is slidably mounted onto the lower base portion, with the ability to move upward and downward.” *Id.* at 2:66-3:2. The propeller shaft immobilizer apparatus of Boudreaux also includes “a lower and upper engaging means” (pink, respectively, in Boudreaux Figure 2, annotated below), that are “mounted on the upper base portion which are movable to frictionally engage the propeller [shaft] to be immobilized” using brake shoes (red in Boudreaux Figure 2 below). *Id.* at 3:2-5. The lower and upper engaging means are moved into engagement with the propeller (blue in Boudreaux Figure 1 above and Boudreaux Figure 2 below) “by hydraulic power or the like.” *Id.* at 3:5-8.



138. In order to move the lower and upper engaging means to engage and immobilize the shaft, “[h]ydraulic fluid is injected into hydraulic cylinders 50....” *Id.* at 6:67-68. When the hydraulic fluid is injected, “[u]pper engaging section 38 [(pink)] is forced to move downward (arrow 85) against the pressure until brake friction means 74 makes friction contact with the upper 1/2 circumferential surface of propeller shaft 11 [(blue)]. Once upper engaging section 38 is unable to move downward due to its contact with shaft 11, the lower engaging section 44 [(pink)] ...

must move upward to counteract the hydraulic force, and likewise, lower brake lining 75 makes contact with the lower section of propeller shaft 11, thus establishing the substantial entire friction contact between brake shoes 74 and 75 [(red in the figure above)] and propeller shaft 11.” *Id.* at 6:67-7:13.

139. Boudreaux further discloses that the inner sections of the semi-circular sections of the upper and lower engaging sections “are provided with a layer of typical brake lining 74 adhered to [semi-circular] sections 65 through riveting or the like, to provide strong frictional engagement between engaging means 38 and 44 and shaft 11.” *Id.* at 5:47-51; *see also id.* at 7:58-8:1.

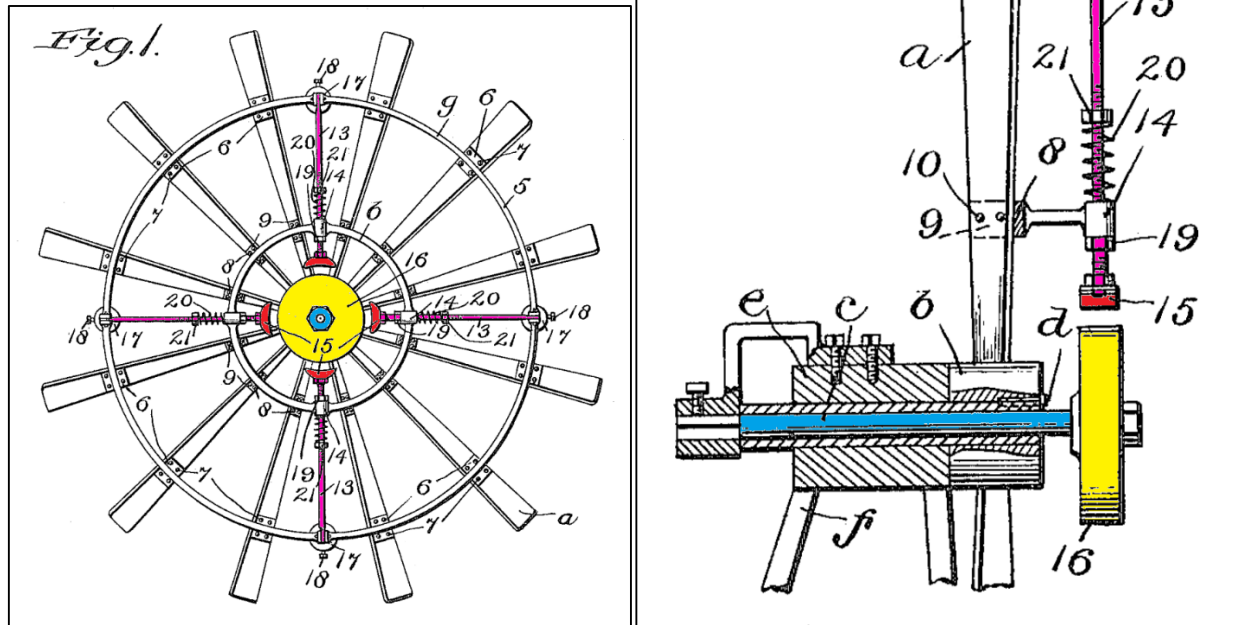
140. Boudreaux further discloses hydraulic valves that can be used to maintain the upper and lower engaging sections either in contact with the shaft, or in a position away from the shaft. When the valve handles are in a closed position, “the hydraulic fluid between valve 69 and hydraulic cylinders 50 [is maintained] in the constant pressurized state, and therefore maintain apparatus 10 in the closed position around propeller shaft 11. Likewise in order to free propeller shaft 11, valve 62A is open, and the hydraulic pressure is therefore relieved, and lower section 44 drops back into place against the upper portion of mounting post 18, and upper section 38 is moved upward due to the expansion of springs within hydraulic cylinders 50, thus providing 1/2 inch clearance space 90 for clear rotation of shaft 11 during use.” *Id.* at 7:14-29.

141. Finally, in the event that hydraulic pressure is not available, Boudreaux discloses manual activation of the propeller shaft immobilizer apparatus by the use of threaded bolts: “In order to manually set the apparatus in frictional engagement with shaft 11, the head of bolts 28 through 31 are rotated by a wrench or the like, which would cause bolts 28 through 31, since they are threaded through the floor 22 of apparatus 10, would lower the upper engaging section 38 and frictional engagement with shaft 11, and likewise raise lower engaging section 44 in frictional engagement, as seen in FIG. 4.” *Id.* at 7:58-8:10.

B. Bisbee

142. U.S. Patent No. 1,152,271 (the “’271 Patent” or “Bisbee”) (Ex. 1012), titled “Windmill Brake,” was issued and published on August 31, 1915. The application that led to Bisbee, U.S. Patent Application No. 754,421, was filed on March 15, 1913. Bisbee is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

143. Bisbee discloses a windmill brake comprising multiple pressure mandrels with tap shoes symmetrically arranged around a friction disc on the drive shaft. As the blades turn more quickly, centrifugal force on connected weights causes the mandals automatically engage the friction disc.



Bisbee, Figures 1 and 2 (annotated).

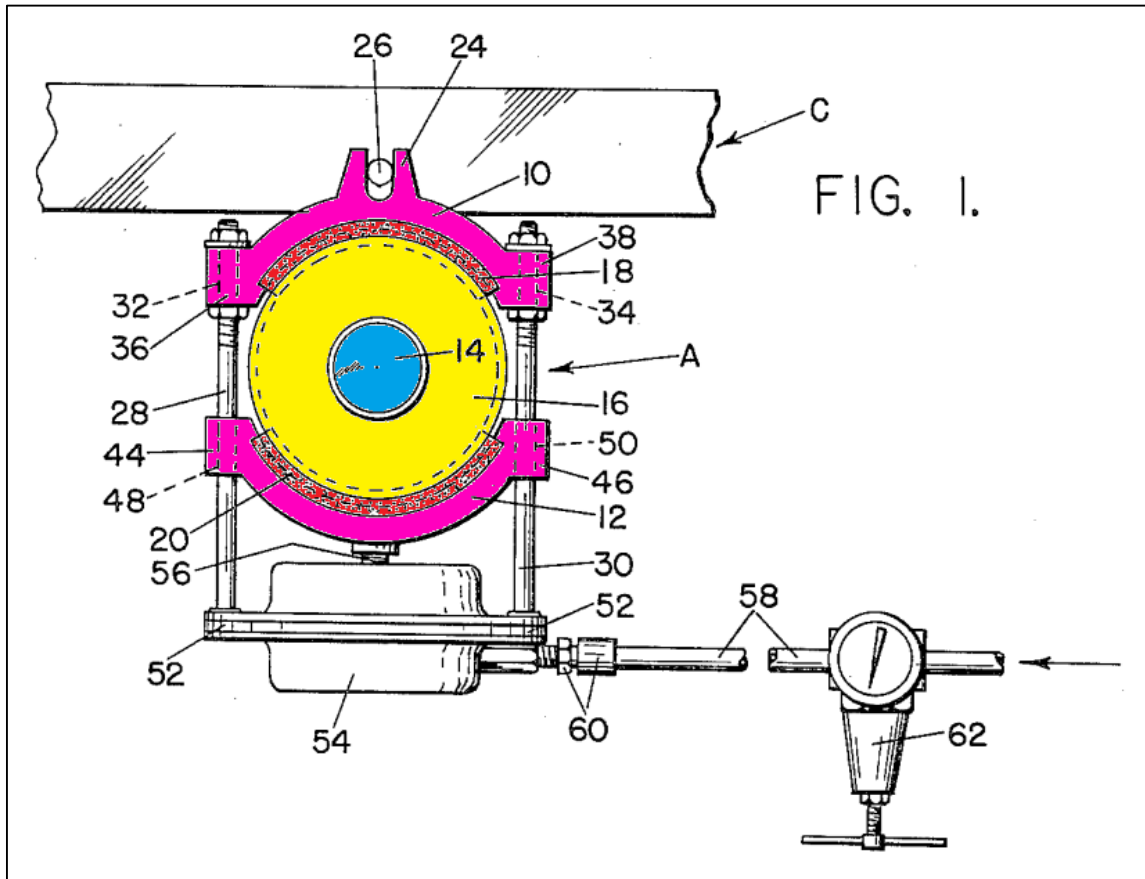
144. More specifically, Bisbee discloses “[a] series of levers 11 [(pink in Bisbee Figures 1 and 2 above)] are fulcrumed on the annulus 5 and between the blades a. The ends of these levers are suitably connected such as by pin and slot connections 12, to the outer ends of rods 13, which rods are slidingly fitted in guides 14 carried by the inner annulus 8 and have at their inner ends friction shoes 15 [(red in Bisbee Figures 1 and 2 above)] arranged in the plane of a friction disk 16 [(yellow in Bisbee Figures 1 and 2 above)] located concentrically at one end of the drive shaft c [(blue in Bisbee Figures 1 and 2 above)].” *Id.* at 1:53-67. “Weights 17 on the

power ends of the levers 11, operate to move the levers and rods, whereby, to effect frictional contact between the shoes and disk when the weights move outwardly under centrifugal force attained by the rotation of the propeller.” *Id.* at 1:67-79.

C. Schilling

145. U.S. Patent No. 3,036,667 (the “’667 Patent” or “Schilling”) (Ex. 1015), titled “Friction Brakes,” was issued and published on May 29, 1962. The application that led to Schilling, U.S. Patent Application No. 792,033, was filed on February 9, 1959. Schilling is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

146. Schilling discloses “friction brakes and deals particularly with a type of brake designed to resist the rotation of a rotating member such as a roller, shaft, drum or the like.” Schilling at 1:9-12. Schilling’s friction brake comprises a set of symmetrically arranged mandrels with brake shoes [(pink in Schilling Figure 1 below)] with heat resistant liners [(red in Schilling Figure 1 below)] to engage a roller [(yellow in Schilling Figure 1 below)], or a stub shaft 14 [(blue in Schilling Figure 1 below)] of the roller where the amount of engagement/friction can be adjusted with air or fluid in a bladder (*e.g.*, hydraulic fluid).



Schilling, Figure 1 (annotated).

147. More specifically, Schilling discloses “a friction brake adapted to be readily installed on an exposed end of a shaft, or upon a drum or similar rotatable member and which is actuated by air or another suitable fluid through the use of a conventional diaphragm.” *Id.* at 1:29-34. The pressure applied by the brake is adjusted by the use of a control valve 62. *See id.* at 3:27-31; *see also id.* at 1:51-57.

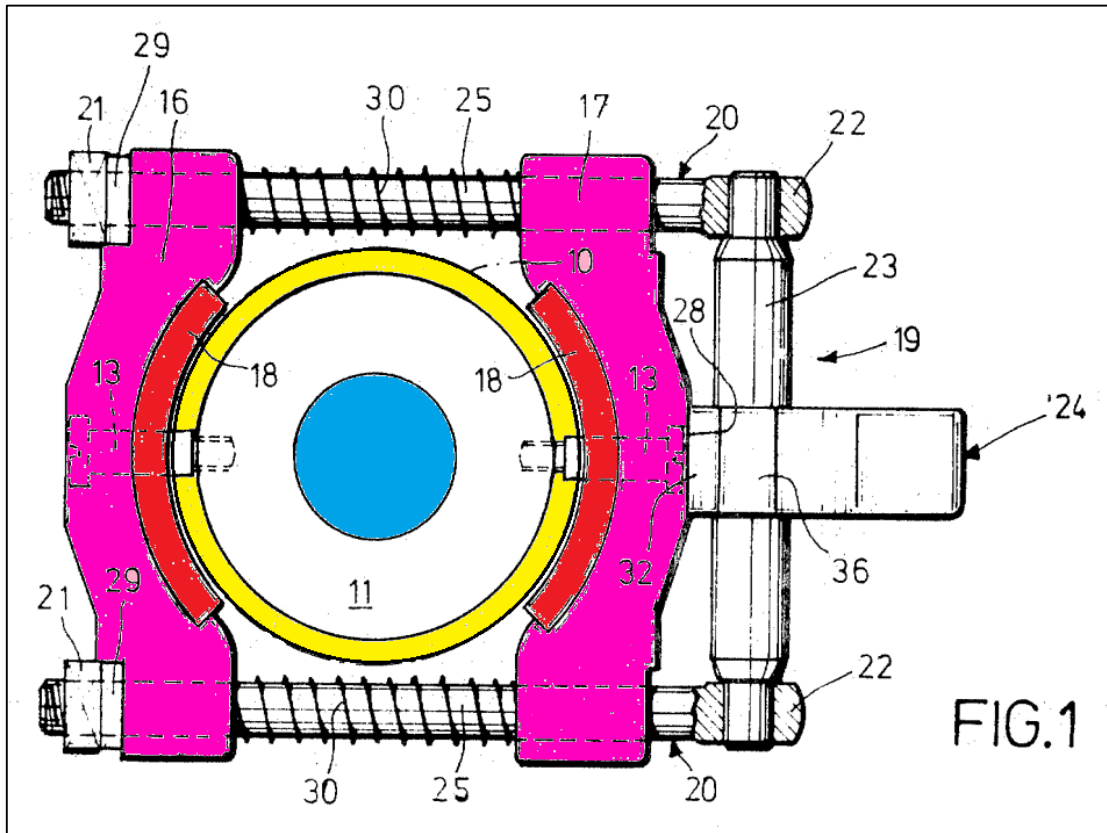
148. The brake shoes (pink in Schilling Figure 1 above) “are provided with liners [(red in the Schilling Figure 1 above)] made of a suitable heat resisting material and are directly engageable with the surface of the rotatable member,” and

“are properly supported in transverse alignment with a rotatable member and are supported for transverse movement toward and away from a rotatable member.” *Id.* at 1:35-44.

D. Fetzer

149. U.S. Patent No. 3,731,768 (the “’768 Patent” or “Fetzer”) (Ex. 1016), titled “External Shoe Brake Particularly for Spinning and Twisting Spindles,” was issued and published on May 8, 1973. The application that led to Fetzer, U.S. Patent Application No. 133,559, was filed on April 13, 1971. Fetzer is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

150. Fetzer discloses a brake comprising a set of two mandrels with tap shoes where the brakes can be engaged/applied using a lever. The friction brake of Fetzer “includes a manually operable pivotable brake lever to draw towards one another two brake shoes [(pink in Fetzer Figure 1 below)] for engaging an interposed spindle to be braked.” Fetzer at Abstract. “The brake shoes, 16, 17 are mirror images of one another and comprise brake linings 18 [(red in Fetzer Figure 1 below)] at their faces adjacent the friction face 10 of the spindle.” *Id.* at 2:27-29.



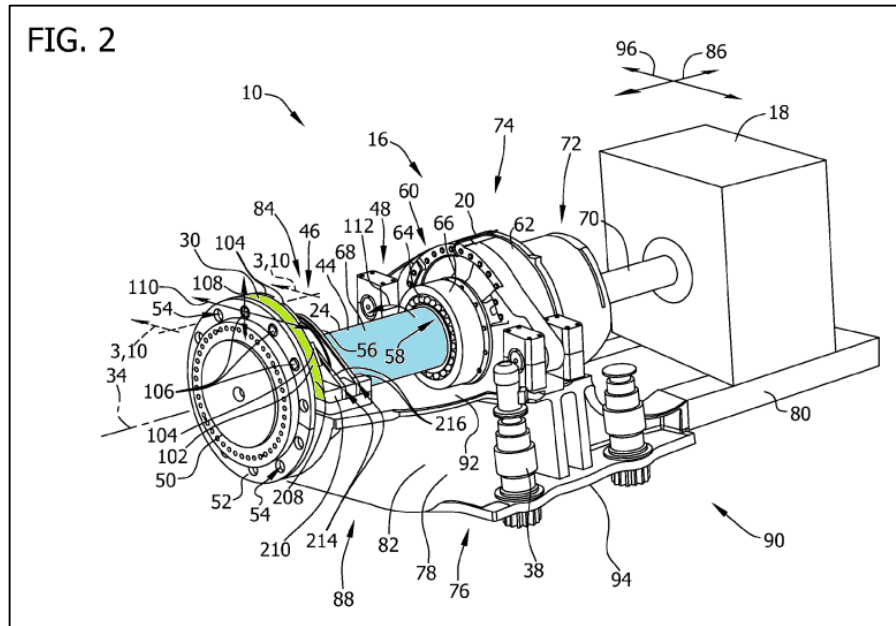
Fetzer, Figure 1 (annotated).

151. When the pivotable brake lever is operated, “nuts 21 serve to displace the first brake shoe 16 [(pink in Fetzer Figure 1 above)] towards the friction face 10 [(yellow in Fetzer Figure 1 above)] and further serve for setting the magnitude of the braking force in the stable position 34 of the lever 24. Between each nut 21 and an adjacent portion of the first brake shoe 16 there is provided an elastic disc 29. Between the two brake shoes 16 and 17 [(pink in Fetzer Figure 1 above)] each bar 20 is surrounded by a biased compression spring 30 which continuously urges the two brake shoes 16, 17 into positions in which they are disengaged from the brake face 10 of the spindle.” *Id.* at 2:45-59.

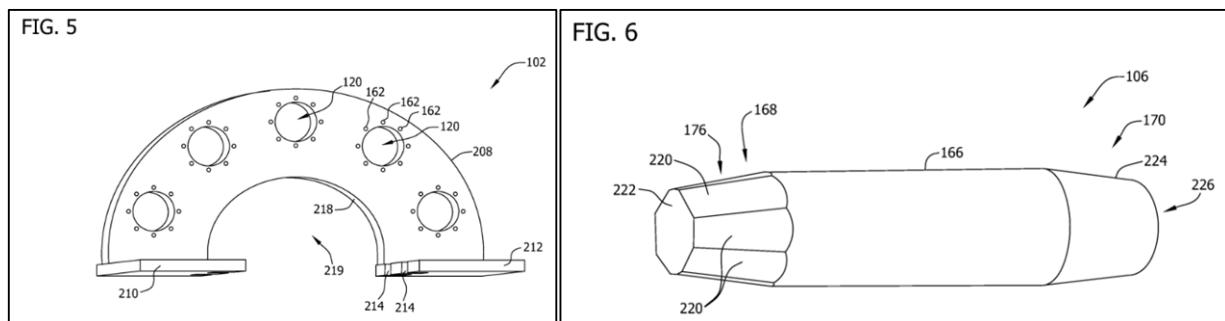
E. Koronkiewicz

152. U.S. Patent No. 8,556,591 (the “591 Patent” or “Koronkiewicz”) (Ex. 1017), titled “Systems and Methods for Assembling a Rotor Lock Assembly for Use in a Wind Turbine,” was issued and published on October 15, 2013. The application that led to Koronkiewicz, U.S. Patent Application No. 12/764,364, was filed on April 21, 2010. Koronkiewicz is prior art under at least AIA 35 U.S.C. §§ 102(a)(1) and (2).

153. Koronkiewicz discloses a “rotor lock assembly” (green in Koronkiewicz Figure 2 below) to “facilitate[] uniformly distributing a rotational moment of the rotor shaft [(blue in Koronkiewicz Figure 2 below)] to a bedplate support frame to facilitate limiting a rotation of the rotor shaft” (blue in Koronkiewicz Figure 2 below) in order to “facilitate repair and/or replacement of wind turbine components uptower of the wind turbine.” Koronkiewicz at 2:29-34.



154. More specifically, in the exemplary embodiment of Koronkiewicz, “rotor lock assembly 30 is coupled to front section 88 of bedplate frame 78 and is coupled to rotor lock disk 52 to facilitate limiting a rotation of rotor shaft 24.” Koronkiewicz at 4:57-5:4.



155. As depicted in Koronkiewicz Figure 5 and 6, above, “[r]otor lock assembly 30 includes a support frame 102 coupled to bedplate frame 78, a plurality of lock pin housings 104 coupled to support frame 102, and a plurality of lock pins 106 coupled to each lock pin housing 104 and adapted to contact rotor lock disk 52.

Each lock pin 106 is configured to be inserted through a corresponding rotor lock disk opening 54 to facilitate coupling rotor lock assembly 30 to rotor lock disk 52.”

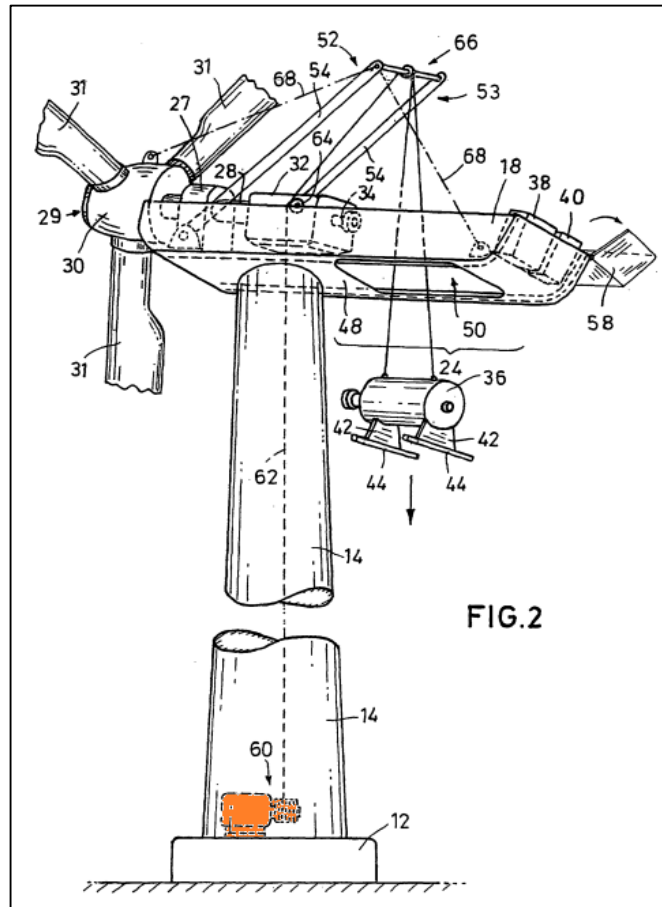
Koronkiewicz at 4:57-5:4.

F. Weitkamp

156. European Patent No. 1,101,934 (the “’934 Patent” or “Weitkamp”) (Ex. 1018), titled “Wind Turbine Having a Movable Crane in the Nacelle,” was issued and published on January 12, 2005. The application that led to Weitkamp, European Patent Application No. EP00125085.1, was filed on November 17, 2000. Weitkamp is prior art under at least AIA 35 U.S.C. § 102(a)(1).

157. Weitkamp discloses an on-board crane system for replacing the main components of the machine housing of a wind turbine. Weitkamp, [0001], [0008].²⁶ Weitkamp further discloses “[a] rope winch 60 [(orange in Weitkamp Figure 2 below)] can be mounted at the bottom of the foundation 12 of the tower 14, from which a rope 62 runs inside the tower or outside of the tower 14 past into the machine housing 18, and from there via a deflection roller 64 to the upper end 66 of the crane arms 54.” *Id.* [0022]; *see also id.* [0013] (“[I]t is advisable to arrange a rope winch [(60)] or similar load-pulling device drive on the foundation ... of the tower ...”).

²⁶ All citations to Weitkamp are to a certified translation of Weitkamp, which is included in Exhibit 1018. Ex. 1018 at 16 of 32.



XII. SPECIFIC GROUNDS FOR INVALIDITY

A. Ground 1: Claims 1-4, 6-8, 10, and 13-14 are Rendered Obvious by the Combination of Signore and Weaver in View of Power Climber, Holloway, and/or Stegemann

1. A POSITA Would Have Been Motivated to Combine Signore and Weaver with a Reasonable Expectation of Success

158. Weaver discloses “methods and apparatus that assist in the removal [and] replacement of gearboxes in wind turbine generators without requiring the removal of blades from the wind turbine generator.” Weaver, [0001]. Weaver discloses a wind turbine shaft restraining member (400) that is lifted into place and

placed on top of the wind turbine's rotor shaft. *See* Weaver, [0015]. Hydraulically or mechanically operated friction brakes (518) in the restraining member clamp the main shaft (402) and prevent it from rotating. *See* Weaver, [0016]-[0017]. In addition, Weaver also discloses a rotor lock that employs bolts placed through the rotor lock and the rotor flange via mating holes in order to lock rotation of the rotor shaft. Weaver discloses that the rotor lock is used to “assist in the removal replacement of gearboxes in wind turbine generators without requiring the removal of blades from the wind turbine generator.” *See id.* at [0001].

159. Signore similarly relates to repair of wind turbines, “more specifically, to a component handling system for use in removing a component of a drive train assembly from the wind turbine.” Signore at [0001]. Further, Signore specifically discusses the need for removal and replacement of gearboxes in wind turbine generators without requiring the removal of blades from the wind turbine generator. Signore explains that “[o]ver time, drive train assembly components 114 [of a wind turbine] such as, for example gearbox 28 ... may be damaged and need to be repaired and/or replaced.” Signore at [0029]. As such, Signore discloses a “[c]omponent handling system 112 [that] enables a user to remove and/or install component 114 uptower of wind turbine 10,” and that “is configured to support drive shaft 24 and rotor 22 from support frame 16, and to facilitate preventing a movement of drive shaft 24 to facilitate coupling and/or decoupling component 114 from drive shaft

24.” *Id.*; *see also id.* at [0001]. Signore further discloses a rotor lock that uses bolts placed through the rotor lock and the rotor flange via mating holes in order to lock rotation of a wind turbine rotor shaft.

160. Signore and Weaver both were concerned with the cost and difficulty of known repair methods for wind turbines that required removal of the rotor assembly prior to repair. *Compare* Weaver at [0001] (“This invention relates generally to methods and apparatus that assist in the removal replacement of gearboxes in wind turbine generators ***without requiring the removal of blades from the wind turbine generator.***”), [0004] (“In at least one known method for replacing a gearbox in a wind turbine..., the blades have to be removed from the rotor before the gearbox is removed. The sheer size of the wind turbines ***makes servicing difficult and expensive***.... Two cranes are required in some cases, because the entire rotor set must be removed in some cases and brought to the ground. A second crane is used to grab the bottom blade of the rotor and to ‘tail it out,’ i.e., make it flat in the air so that it can be set on the ground.”), [0007] (“Thus, known methods of replacement or servicing of a gearbox in a wind turbine are ***expensive and labor-intensive.***”) *with* Signore at [0003] (“In at least some known wind turbines, a repair and/or replacement of the drive train component ***requires the rotor assembly to be removed from the drive shaft***, and the nacelle, drive shaft, gearbox, and generator to be removed from the wind turbine tower prior to removing the component from

the drive shaft and repairing and/or replacing the damaged component....[A]s such, repairing worn or damaged drive train components can be ***costly and time-consuming.***”), [0016] (“By providing a component handling system that enables a drive train component to be coupled and/or decoupled from the drive shaft uptower of the wind turbine, the need for large lifting cranes is reduced. As such, ***the cost and manpower required to remove and/or replace the drive train component is significantly reduced.***”).

161. A POSITA would have been motivated, at the time of the priority date of the '578 Patent, to combine the multiple pressure mandrels taught by Weaver with the device taught by Signore because they would provide greater applicability to a wider range of wind turbine shaft diameters, and they would also improve the friction retention of the wind turbine's main shaft. Both of these advantages would have been obvious to a POSITA and would have led them to modify the device taught by Signore as described.

162. Further, Signore and Weaver both use friction to inhibit rotation of the shaft. *Compare* Weaver [0017] (“Hydraulic or mechanically operated ***friction*** brakes 518 are provided in some configurations to clamp main shaft 402 and thereby inhibit rotation of shaft 402.”) *with* Signore App. [0053] (“In the exemplary embodiment, a plurality of torque clamps 244 are coupled to interior surfaces 240, and are oriented circumferentially about opening 242. Each torque clamp 244 is

configured to facilitate coupling restraint assembly 136 to drive shaft 24 via a ***friction*** fit to facilitate limiting a movement of drive shaft 24.”).

163. A POSITA would know that friction force is proportional to normal force times a coefficient of friction. The magnitude of friction force, therefore, depends on the magnitude of normal force acting on the friction surfaces. It was well known at the time of the '578 Patent that a hydraulic or mechanically operated brake clamp is one way to achieve an increased normal force. Therefore, a POSITA would be motivated to combine the hydraulically or mechanically operated friction brakes taught by Weaver into the shaft restraint taught by Signore.

164. In addition, in the prosecution of both the '518 Patent (a parent to the '578 Patent), and the '578 Patent, the examiner issued Non-Final Rejections, rejecting pending claims as obvious over Signore in view of Weaver. *See supra* Sections VII.B & VII.C. In doing so, the examiner necessarily found that a POSITA would have been motivated to combine Signore and Weaver.

165. In addition, every element of the above-referenced claims appears in Signore and Weaver. *See infra* §§ XII.A.5 - XII.A.14. Those elements are standard components that would be familiar to any POSITA. There is nothing unpredictable, surprising, or unexpected about the claimed use of those components in the practice of uptower maintenance of a wind turbine. Furthermore, the technology and operation of such mechanical components was well-understood in the relevant time

period such that the combination of Signore and Weaver would have had a high likelihood of success. In particular, the torque clamps 244 of Signore correspond to surfaces 520 of Weaver and it would be straightforward for a POSITA to make Signore's torque clamps adjustable with the use of Weaver's friction brakes 18.

166. Thus, because (i) Signore and Weaver teach the same kind of device used for the same purpose, (ii) Signore and Weaver identified the same problem identified in the '578 Patent and solved it in the same way, (iii) the elements of Signore and Weaver were old elements performing the same function they had always been known to perform, (iv) the combination of elements in the Challenged Claims is nothing more than the predictable use of prior art elements according to their established functions, and (v) the combination of Signore and Weaver would have had a high likelihood of success, a POSITA would have been motivated to combine Signore and Weaver.

**2. A POSITA Would Have Been Motivated to Combine
Signore and Weaver with Power Climber with a Reasonable
Expectation of Success**

167. Like Signore and Weaver, Power Climber relates to uptower repair of wind turbines. Power Climber Wind, the company behind Power Climber, "helps major wind turbine OEMs, owners and service providers manage their **operation and maintenance** costs by providing the most reliable access equipment and expertise to improve employee safety, productivity and retention." Ex. 1023. Power

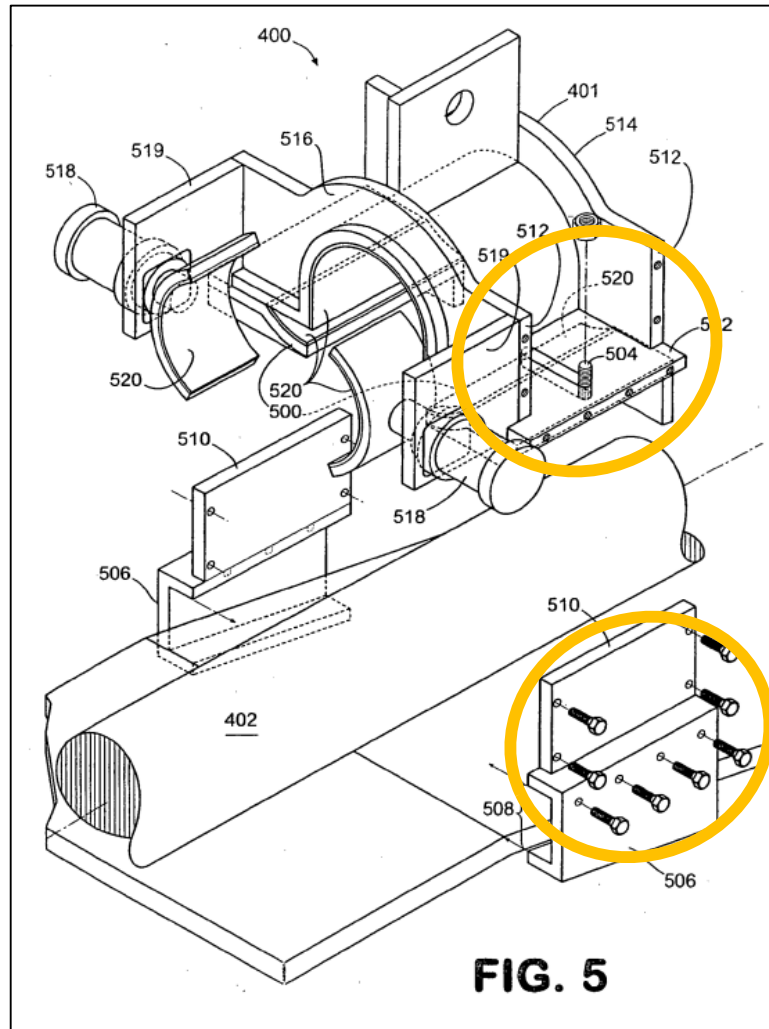
Climber Wind describes itself as “[t]he world leader in suspended access with 65 years experience **putting people to work at elevation** with motorized solutions,” with a “commitment to **performing productively at elevation....**” *Id.* In particular, Power Climber notes the risk of “potential technician fatigue and injury from manually carrying tools from the wind turbines’ yaw deck to the nacelle” for repairs. *Id.* The Nacelle Davit described in Power Climber “improves technician safety and productivity,” and “provided a safer material transfer solution.” *Id.*

168. A POSITA would have recognized, as of the priority date of the ’578 Patent, that the teachings of Power Climber are directed to the same problem as Signore and Weaver; namely performing major wind turbine maintenance activities quickly, safely, and efficiently up-tower without the use of a large mobile crane. The Nacelle Davit taught by Power Climber is compatible with the main shaft fixtures taught by Signore and Weaver in order to achieve the advantages taught by Power Climber. The use of a Nacelle Davit, as taught by Power Climber, together with the main shaft fixtures taught by Signore and Weaver provides expected benefits that would have been anticipated by a POSITA, and does not provide any surprising or unexpected results when combined with a main shaft fixture. A POSITA would have been motivated to use a lightweight or self-hoisting crane to avoid the expense of a large mobile crane. In the case of a lightweight crane, a POSITA would have

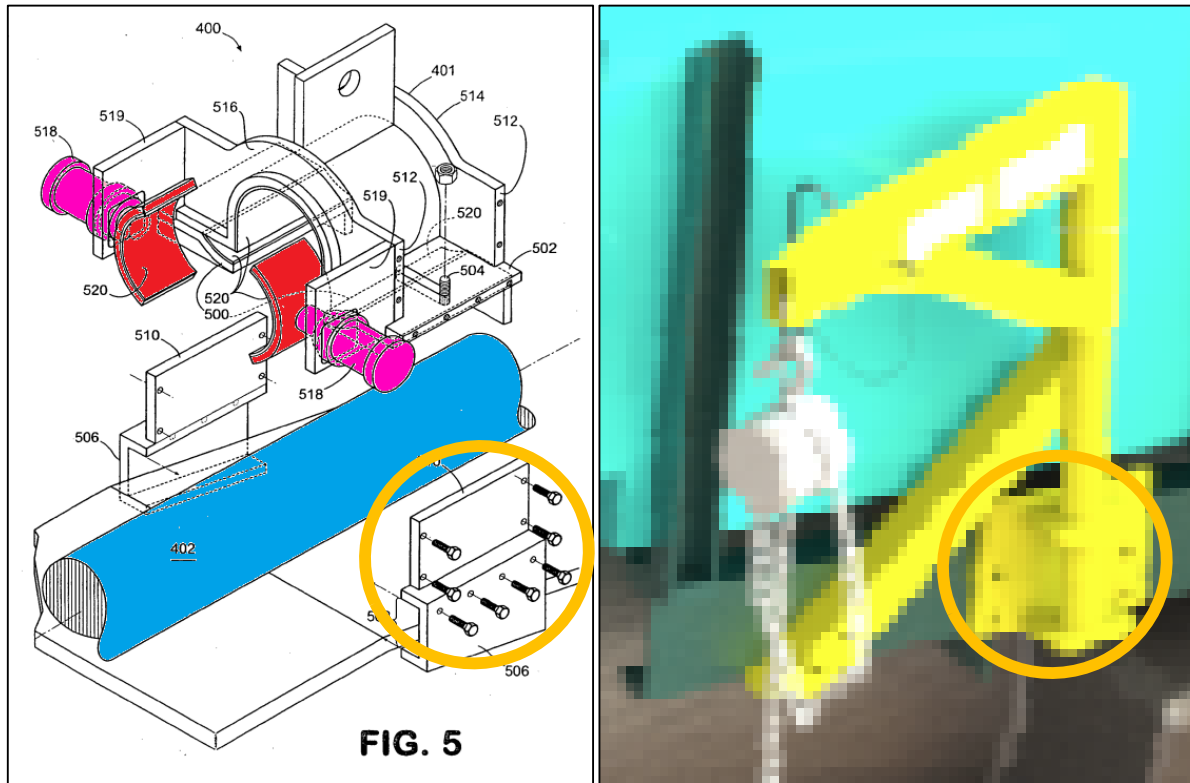
known that such a crane could be used for lifting a larger, more capable nacelle-mounted crane to lift major nacelle components if necessary.

169. Further, a POSITA would find it advantageous to mount the Nacelle Davit, as taught by Power Climber, to a main shaft fixture (and would expect success in doing so) because the main shaft fixture is a strong and solid structure that, by way of its attachment to the nacelle frame, is part of a unitary structure together with the nacelle frame. Furthermore, the main shaft fixture, as taught by Signore and Weaver, creates a consistent structure in each wind turbine whereas other structures and surfaces in the wind turbine, such as the bedplate, the gearbox, lifting eyes, main bearings, generators, etc. can vary in size and location from wind turbine by wind turbine.

170. I note that Weaver discloses that the oil cooler 302 is removed so that it will not “interfere with the installation of a shaft-restraining collar” (*i.e.* a main shaft fixture). Weaver at [0014]. A POSITA would understand that it would be advantageous to provide mounting points that do not depend on the presence of an oil cooler, and that wing 502, stiffening plate 510, or channel clamp 506 depicted in Figure 5 of Weaver (each of which contain bolt holes, depicted in orange below) would make a logical mounting location for the Nacelle Davit taught by Power Climber, either with or without an installed oil cooler.



Therefore, a POSITA, when faced with the design choice of selecting a mounting location for a portable crane, would be motivated to use the teachings of Power Climber to add “mounting facilities adapted for anchoring a crane” to the main shaft fixture taught by Signore and Weaver.



3. A POSITA Would Have Been Motivated to Combine Signore and Weaver with Stegemann and/or Holloway with a Reasonable Expectation of Success

171. Like Signore and Weaver, Stegemann and Holloway recognize the need for installation/service/repair of wind turbine components, which can be expensive to move with large cranes. *Compare* Weaver [0004] (“The sheer size of the wind turbines makes servicing difficult and expensive, as at the 65 to 80 meter height of some wind turbines used in generator farms, **a large crane is required.**”) and Signore [0016] (“By providing a component handling system that enables a drive train component to be coupled and/or decoupled from the drive shaft uptower of the wind turbine, **the need for large lifting cranes is reduced.**”) with Stegemann at [0005] (“Components in the wind turbine typically have to be installed, serviced or

replaced using mobile land-based cranes and/or manually carrying components to remove and/or replace components. Wind turbine components may be huge or awkward to handle, precluding manual transportation of the components. Further, wind turbines may be installed on uneven terrain and/or on very high towers (*e.g.*, towers that are at least 60 meters in height) that are inaccessible to mobile land-based cranes. In addition, ***operation of mobile land-based cranes is expensive.***”) and Holloway at 1:30-43 (“***Known apparatus*** for moving such components into and within a wind turbine ***can be bulky, dangerous, and expensive....*** In particular, ***portable cranes which are lightweight, inexpensive, and have high load capacities would be advantageous.***”). Moreover, the ’578 Patent itself admits as prior art the use of self-hoisting cranes in the nacelle because “the use of such involves large savings in the level of expenses for servicing wind turbines since the use of large mobile cranes for handling the above-mentioned large and heavy components is made superfluous.” Ex. 1001 at 2:1-5.

172. Like Signore and Weaver, an objective of both Stegemann and Holloway is an inexpensive method of servicing wind turbine components. *Compare* Weaver at [0004] (“In at least one known method for replacing a gearbox in a wind turbine..., the blades have to be removed from the rotor before the gearbox is removed. The sheer size of the wind turbines ***makes servicing difficult and expensive....*** Two cranes are required in some cases, because the entire rotor set

must be removed in some cases and brought to the ground. A second crane is used to grab the bottom blade of the rotor and to ‘tail it out,’ i.e., make it flat in the air so that it can be set on the ground.”), [0007] (“Thus, known methods of replacement or servicing of a gearbox in a wind turbine are **expensive and labor-intensive.**”) and Signore at [0003] (“In at least some known wind turbines, a repair and/or replacement of the drive train component **requires the rotor assembly to be removed from the drive shaft**, and the nacelle, drive shaft, gearbox, and generator to be removed from the wind turbine tower prior to removing the component from the drive shaft and repairing and/or replacing the damaged component....[A]s such, repairing worn or damaged drive train components can be **costly and time-consuming.**”), [0016] (“By providing a component handling system that enables a drive train component to be coupled and/or decoupled from the drive shaft up tower of the wind turbine, the need for large lifting cranes is reduced. As such, **the cost and manpower required to remove and/or replace the drive train component is significantly reduced.**”) with Stegemann at [0006] (“Therefore, what is needed is an **inexpensive** method and apparatus for installing, servicing or replacing components in wind turbines that is portable, lightweight and/or is capable of operation at the operating heights of wind turbines and in the various terrains in which wind turbines may be installed.”) and Holloway at 1:39-43 (“Accordingly, improved apparatus for moving relatively heavy components into and within wind turbines are desired. In

particular, portable cranes which are lightweight, inexpensive, and have high load capacities would be advantageous.”).

173. Stegemann provides a number of reasons why it would be beneficial to use a portable crane in a wide range of wind turbine repair situations. *See* Stegemann at [0010]-[0015].

174. For example, Stegemann indicates that “[an] advantage ... is that the components may be transported to and from the wind turbine, even when the wind turbine is installed on rugged terrain or when installed offshore,” and that a portable crane assembly “may disassemble into components easily carried by installers and/or servicers.” *Id.* at [0012], [0011]. A POSITA would understand that when repairing or replacing wind turbine components, it is advantageous to utilize tools that can be assembled from lightweight sub-components to allow the equipment to be easily hoisted into the wind turbine nacelle and handled within the nacelle without presenting a danger of injury to the wind turbine technicians. A POSITA would also know how expensive mobile cranes are and would be motivated to utilize a portable crane that would obviate the need for a large mobile crane.

175. Stegemann further teaches that such portable cranes “easily assembled onto existing wind turbines with few, if any, modifications required of current wind turbines.” *Id.* at [0013]. A POSITA would understand that when repairing or replacing wind turbine components, some modifications may be necessary in order

to mount such cranes, and would find it obvious to include mounting facilities on a main shaft fixture, which itself will be installed in a nacelle for wind turbine repair operations. The main shaft fixture, as taught by the '578 Patent, acts like a mounting bracket with respect to the portable crane. It is no different than any other mounting bracket or sturdy mounting point that might be found within the nacelle. Therefore, the main shaft fixture, as taught by the '578 Patent, serves a similar function as attachment plate 311 as taught by Stegemann. Stegemann teaches that the attachment plate 311 "is configured to mate, attach, or otherwise fasten to a component of the wind turbine 100. While not so limited, the attachment plate 311 may attach to or replace existing components, and utilize existing fastening locations." *Id.* at [0039].

176. A POSITA would have also recognized in the relevant time frame that the main shaft fixture taught by Signore would be a convenient mounting location, as taught by Stegemann. A POSITA would particularly recognize the main shaft fixture taught by Signore as a convenient mounting bracket for a crane, as taught by Stegemann, because the main shaft fixture is solidly attached to the wind turbine frame and creates a consistent mounting location across a variety of wind turbine designs and configurations. Furthermore, Stegemann teaches the use of primary 301, 303 and secondary 307 support members to help support and stabilize the portable crane. Stegemann teaches that these primary and secondary support

members “may fasten to existing lifting eyes 513” or “may be clamped or otherwise fastened to lips, features, or surfaces within the wind turbine 100.” *Id.* at [0040]. Therefore, a POSITA would have been motivated to combine the teachings of Stegemann with the devices taught by Signore and Weaver.

177. Further, like Signore and Weaver, Holloway recognizes that objects need to be moved during maintenance/repair of a wind turbine. *Compare* Weaver at Claim 1 (the claimed method comprises “**lifting** (206) a shaft-restraining member or members (400) to the wind turbine; fastening (208) the shaft-restraining member or members to the wind turbine to thereby restrain the shaft from tilting when the gearbox is **removed** from the wind turbine; removing (212) the gearbox from the wind turbine with the shaft-restraining member or members fastened to the wind turbine; re-anchoring (214) the first end of the shaft with a replacement gearbox (300); and removing (216) the shaft-restraining member or members from the wind turbine after the shaft is re-anchored by the replacement gearbox....”) *and* Signore at [0016] (“Moreover, the component handling system described herein includes a **lifting assembly** that is adapted to be coupled to a drive train component, and is configured to **remove** the component from a drive shaft without requiring the drive shaft and/or a rotor to be removed from the wind turbine.”) *with* Holloway at 1:39-40 (“Accordingly, improved apparatus for **moving** relatively heavy components into and within wind turbines are desired.”).

178. Holloway contemplates attaching a crane to “a plurality of wind turbine 10 components...” and recognizes that “[t]he use of various interchangeable mount assemblies in accordance with the present disclosure advantageously facilitates the portability of the crane 120.” See Holloway at 5:34-59.

179. A POSITA would be familiar with service hoists and cranes that have been provided as standard equipment in nearly all utility-scale wind turbines since the 1990s, but that have limited lifting capacity and limited range of locations they can access within the wind turbine nacelle. The limitations of these standard on-board hoists and cranes is well known in the art. Replacing large components within the nacelle, such as gearboxes as taught by Signore and Weaver, would exceed the capacity of the small on-board service hoist or crane supplied with the wind turbine, and this would be recognized by a POSITA. A portable crane, such as the one taught by Holloway, would be recognized by a POSITA as a useful addition to the devices taught by Signore and Weaver. Holloway teaches the attachment of portable crane to a door (Holloway at 6:16-18), a bedplate (*id.* at 6:35-37), a gearbox (*id.* at 6:52-53), a brake caliper of a gearbox (*id.* at 7:2-5), a generator, yaw platform, an uptower platform, a downtower platform, the hub, the main shaft, the main bearing, etc. See *id.* 7:20-39. It is clear from the variety of mounting locations contemplated by Holloway that the choice of mounting location is a matter of design choice, and that a POSITA would be able to select a suitable such mounting location. A main shaft

fixture, as taught by Signore and Weaver, would be securely fastened to the frame of the nacelle and, from a structural standpoint, would be an extension of the nacelle frame, and therefore would serve as one option that a POSITA would recognize as a useful attachment point based on the teachings of Holloway. A POSITA would be motivated to add such a portable crane to the devices taught by Signore and Weaver in order to augment the lifting capability of the standard on-board crane.

180. Further, a POSITA would find it advantageous to mount the portable crane taught by Holloway to a main shaft fixture (and would expect success in doing so) because the main shaft fixture is a strong and solid structure that, by way of its attachment to the nacelle frame, is part of a unitary structure together with the nacelle frame. Furthermore, the main shaft fixture, as taught by Signore and Weaver, creates a consistent structure in each wind turbine whereas other structures and surfaces in the wind turbine, such as the bedplate, the gearbox, lifting eyes, main bearings, generators, etc. can vary in size and location from wind turbine by wind turbine. Therefore, a POSITA, when faced with the design choice of selecting a mounting location for a portable crane, would be motivated to use the teachings of Stegemann and Holloway to add “mounting facilities adapted for anchoring a crane” to the main shaft fixture taught by Signore and Weaver. The use of Holloway and/or Stegemann, together with the main shaft fixtures taught by Signore and Weaver provides

expected benefits that would have been obvious to a POSITA, and does not provide any surprising or unexpected results when combined with a main shaft fixture.

4. The Combination of Signore and Weaver with Power Climber, Stegemann, and/or Holloway Meets All Elements of Challenged Claims 1-4, 6-8, 10, and 13-14

181. As discussed below, the Preambles and every element of Challenged Claims 1-4, 6-8, 10, and 13-14 are taught by the combination of Signore and Weaver with Power Climber, Stegemann, and/or Holloway. To the extent Patent Owner alleges that any of Weaver, Signore, Power Climber, Stegemann, and Holloway fails to teach any claim element, that element is provided by the other references. Further, to the extent the teachings of any of Weaver, Signore, Power Climber, Stegemann, and/or Holloway are substantively different for any given claim element, it would have been at least obvious to try the other references' implementation of that element, given the overall similarity in their purpose, design, and operation and the well-known operation of the mechanical components described in the references.

5. Claim 1

182. Following an April 26, 2024 Non-Final Rejection of then pending claim 1 of the '578 Patent over the combination of Signore and Weaver, on July 26, 2024 Patent Owner argued that "the cited references fail to disclose or suggest, inter alia, 'that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine,' as recited in [pending]

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independent claim 1.” Ex. 1002 (Prosecution History of ’578 Patent), at 73-74 (July
26, 2024 Response to Non-Final Rejection, at 8-9). Patent Owner relied solely on
an argument that the claimed main shaft fixture “further comprises mounting
facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.” Patent
Owner did not otherwise dispute that the combination of Signore and Weaver
disclosed every element of then pending claim 1 as outlined in the April 26, 2024
Non-Final Rejection, nor did Patent Owner make any substantive claim amendments
for purposes of overcoming the asserted prior art. Regardless, every element of
Claim 1 is disclosed by the combination of Signore and Weaver, further in view of
Power Climber, Holloway, and/or Stegemann.

183. Claim 1 is written as a single paragraph without clearly delineated
elements. For purposes of my analysis, I have separated Claim 1 into the following
elements:

1[pre] Main shaft fixture for fixation of a main shaft on a wind turbine
during execution of installation and repair work on heavy parts of a
wind turbine,

1[a] where the fixture is divided up into a number of sections for
mounting on stable structural parts in a nacelle of a wind turbine,
including a bottom frame of the nacelle,

1[b] characterised in that the main shaft fixture comprises adjustable
pressure mandrels with tap shoes,

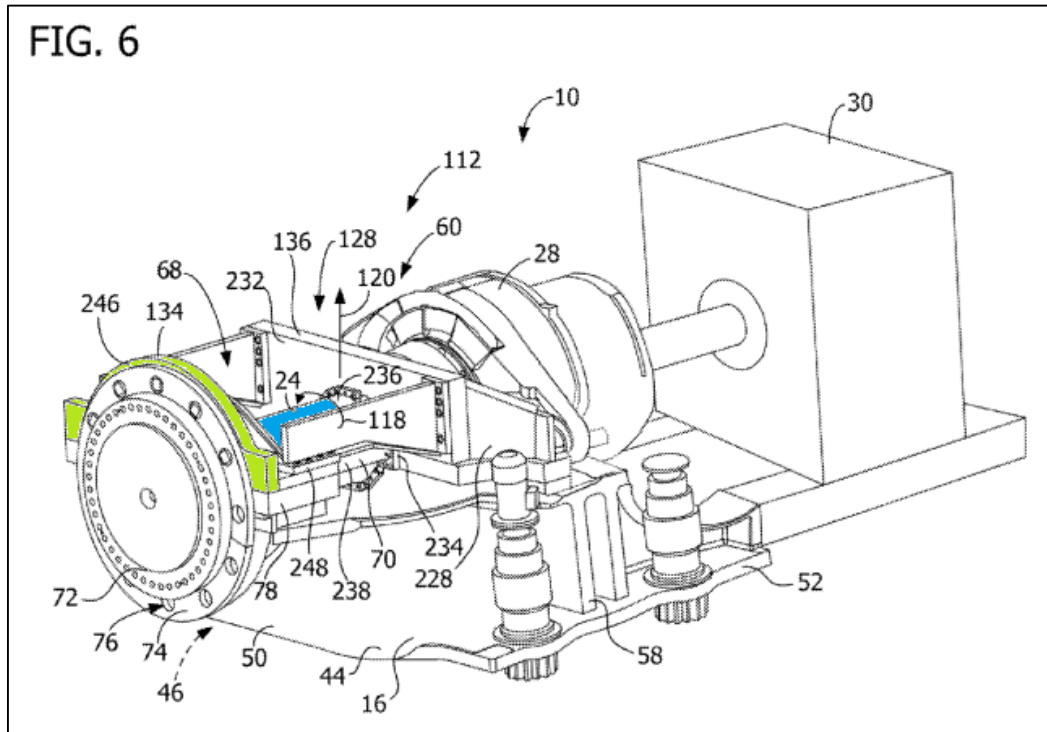
1[c] and the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft

1[d] and in that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.

a. **1[Pre]: “Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine”**

184. I have been informed that this first element of Claim 1 may be considered a preamble and that preambles are not always limiting. For purposes of my analysis, I have been asked to assume that this element is limiting. Each of Signore and Weaver teach this element.

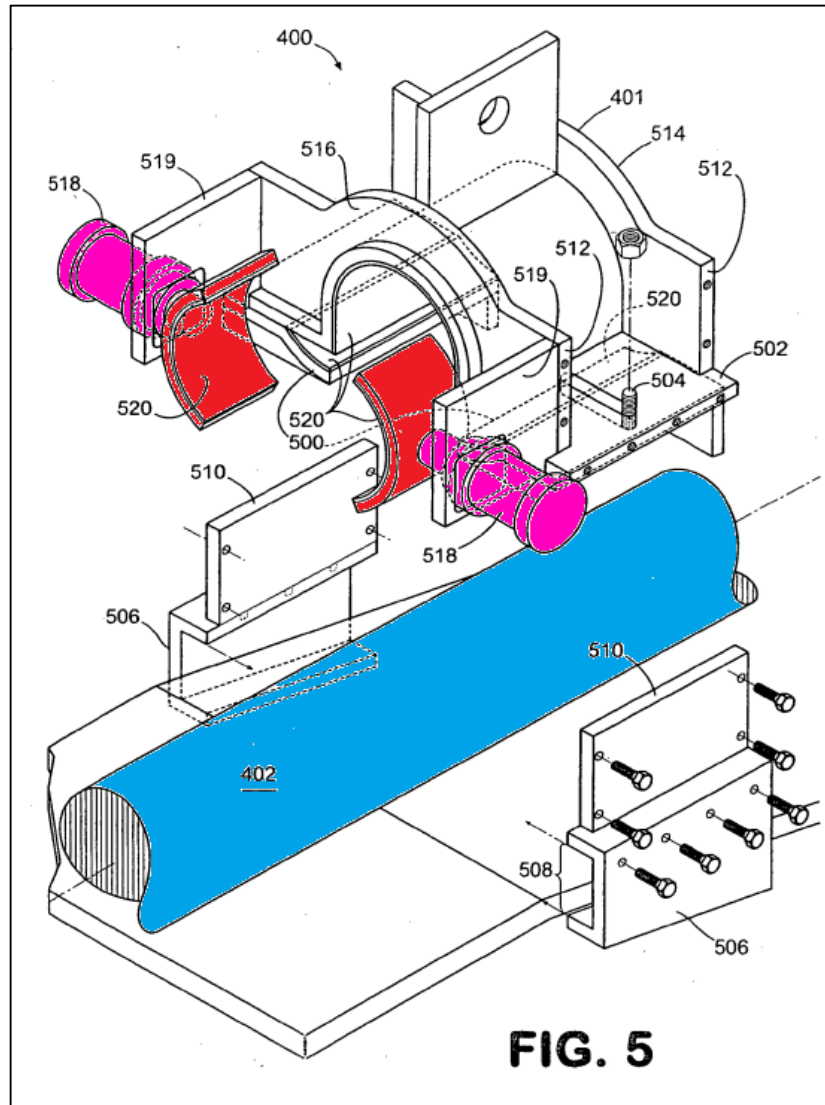
185. Signore discloses a “[c]omponent handling system 112 [that] enables a user to remove and/or install component 114 uptower of wind turbine 10,” and that “is configured to support drive shaft 24 and rotor 22 from support frame 16, and to facilitate preventing a movement of drive shaft 24 to facilitate coupling and/or decoupling component 114 from drive shaft 24.” Signore at [0029]; *see also id.* at [0001].



Signore, Figure 6

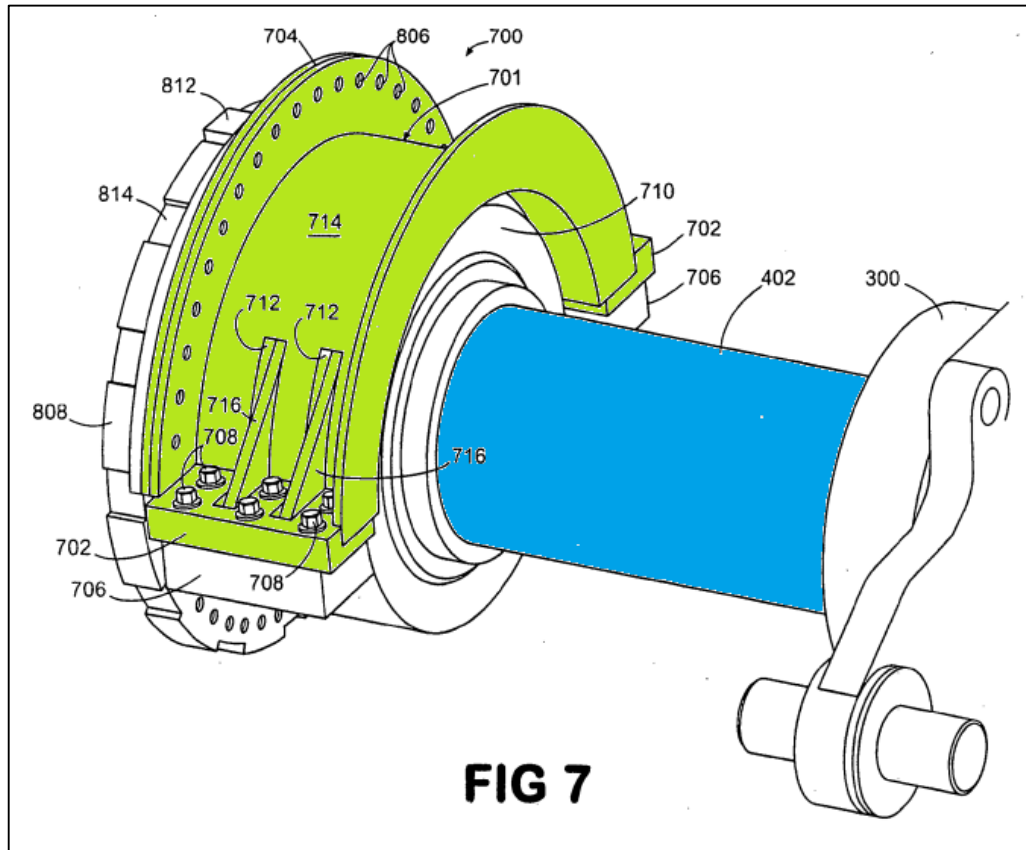
186. In addition, in an April 26, 2024 Office Action, the examiner found that Signore “discloses a main shaft fixture (128), as illustrated in Figures 1-9, for fixation of a main shaft (24) on a wind turbine (10) during execution of installation and repair work on heavy parts of a wind turbine.....” Exhibit 1002, at 87 (April 26, 2024 Non-Final Rejection, at 5). I agree with this finding.

187. Weaver discloses a shaft-restraining member “that is used to restrain rotating shaft 402 ... from tilting from its horizontal position when gearbox 300 is removed from wind turbine 100 without the removal of rotor 104.” Weaver at [0015]. Weaver’s shaft restraining member (400) is lifted into place and placed on top of the wind turbine’s rotor shaft. *See id.* at [0015].



Weaver, Figure 5

188. Weaver also discloses a rotor lock that, when installed, results in a wind turbine shaft that is “effectively restrained from tilting and its rotation effectively inhibited [so that] Gearbox 300 can then be safely removed and replaced.” *Id.* at [0023].



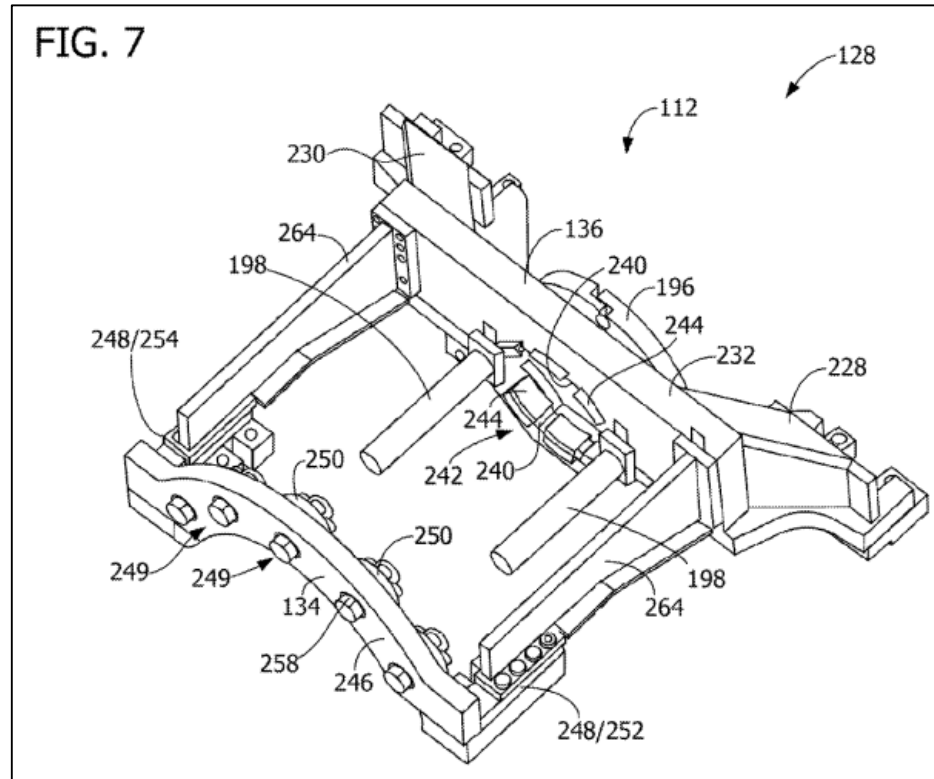
Weaver, Figure 7

189. In addition, in the prosecution of the '578 Patent, Patent Owner did not dispute that the claimed “Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine” was obvious in view of Signore as modified by Weaver. *See supra* Section VII.C.

- b. **1[a]: “where the fixture is divided up into a number of sections for mounting on stable structural parts in a nacelle of a wind turbine, including a bottom frame of the nacelle”**

190. Signore and Weaver each teach this element.

191. Signore teaches that shaft support assembly 128 the fixture is divided up into a number of sections for mounting on stable structural parts in a nacelle of a wind turbine. The “shaft support assembly 128” of Signore “includes a **drive shaft locking assembly 134** and a **restraint assembly 136**. Shaft locking assembly 134 is adapted to be **coupled to support frame 16** and to rotor locking member 74 to facilitate limiting a rotation of drive shaft 24 about drive shaft axis 66.” Signore at [0031].



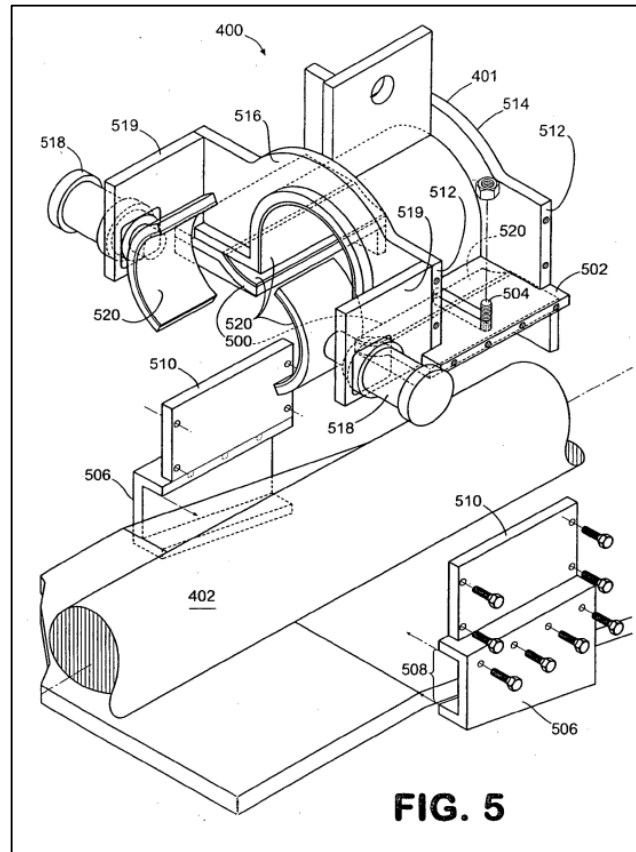
Signore, Figure 7

192. In addition, in an April 26, 2024 Office Action, the examiner found that Signore “discloses a main shaft fixture (128), as illustrated in Figures 1-9, for

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fixation of a main shaft (24) on a wind turbine (10) during execution of installation
and repair work on heavy parts of a wind turbine, ***where the fixture is divided up
into a number of sections for mounting on stable structural parts in a nacelle (18)
of a wind turbine, including the bottom frame (16) of the nacelle...*** Exhibit 1002,
at 87-88 (April 26, 2024 Non-Final Rejection, at 5-6). I agree with this finding.

193. In addition, in the prosecution of the '578 Patent, Patent Owner did not
dispute that the claimed “Main shaft fixture” “divided up into a number of sections
for mounting on stable structural parts in a nacelle of a wind turbine, including a
bottom frame of the nacelle” was disclosed by Signore. *See supra* Section VII.C.

194. Weaver’s fixture is also divided up into a number of sections for
mounting on stable structural parts in a nacelle of a wind turbine, including at least
“[a]n ***additional stiffening plate 510*** [that] is bolted to flanges 512 protruding from
spool ends 514 and 516 of half-spool member 401” and “***channel clamp[s] 506.***”
Weaver at [0016], Figure 5. In addition, Weaver teaches “each mounting wing 502
... is held in place using a channel clamp 506 having a U-shaped channel 508 that
attaches onto ***a bedplate*** (not explicitly shown in Figure 5) ***of wind turbine 100.***”
Id.

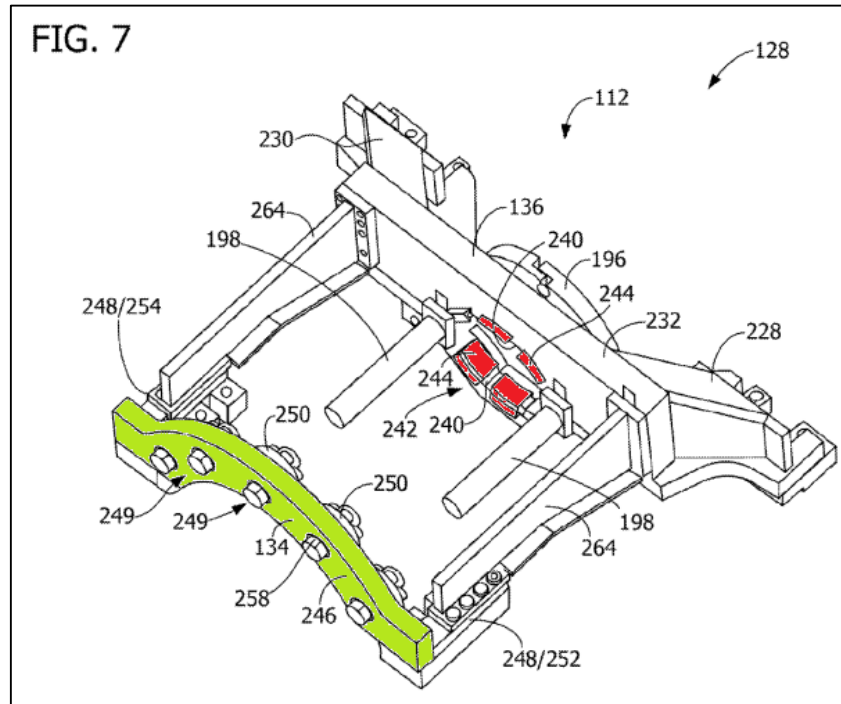


Weaver, Figure 5

- c. **1[b]: “characterized in that the main shaft fixture comprises adjustable pressure mandrels with tap shoes”**

195. Signore and Weaver teach this element.

196. Signore discloses “a plurality of torque clamps 244 are coupled to interior surfaces 240, and are oriented circumferentially about opening 242. Each torque clamp 244 is configured to facilitate coupling restraint assembly 136 to drive shaft 24 via a friction fit to facilitate limiting a movement of drive shaft 24.” Signore at [0053].



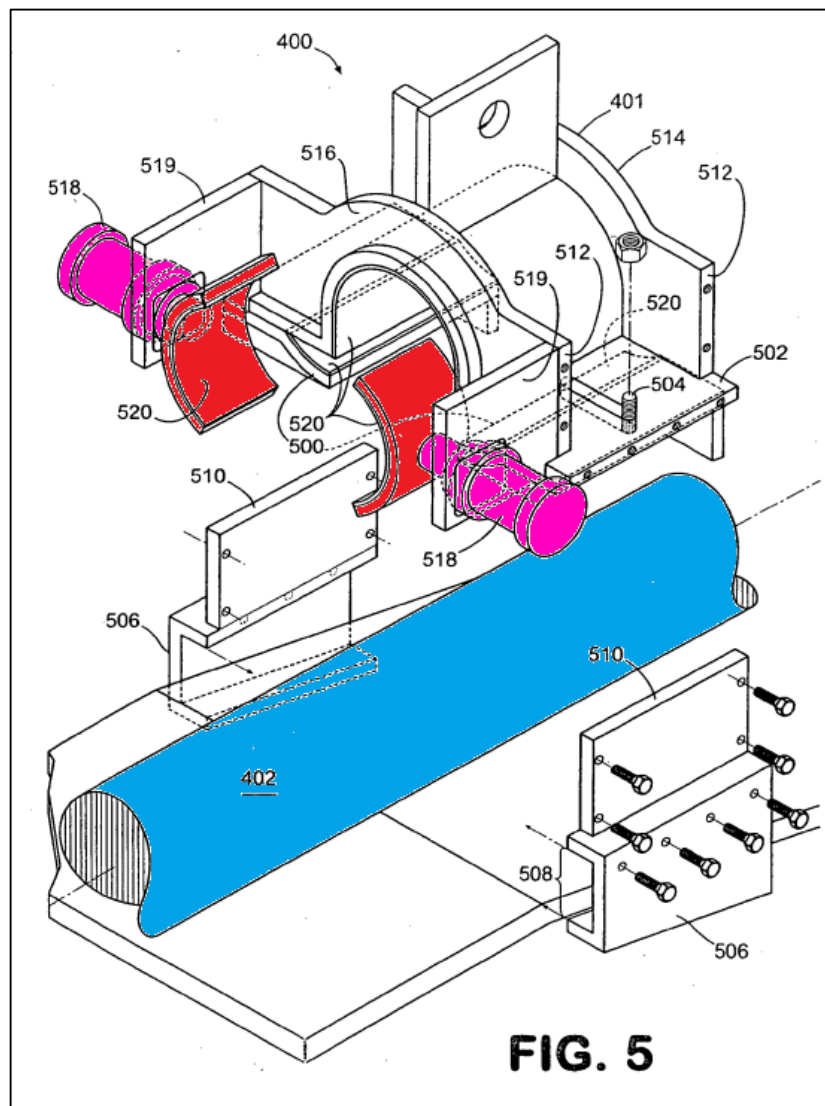
Signore Application, Figure 7

197. In addition, in an April 26, 2024 Office Action, the examiner found that Signore discloses a “main shaft fixture compris[ing] at least three torque clamps (244), substantially symmetrical located around a center axis of the main shaft, to facilitate coupling a restraint assembly (136) to the main shaft to limit a movement of the main shaft.” Exhibit 1002, at 88 (April 26, 2024 Non-Final Rejection, at 6).

198. In that April 26, 2024 Office Action, the examiner also found that “*Weaver et al teaches a shaft restraining member (400) attached to a bed plate of a wind turbine. The shaft restraining member includes hydraulic or mechanic[ally] operated friction brakes (518). The clamping action of brakes (518) resists torque from rotor shaft (402). The hydraulic or mechanic brake comprises cylinders*

supported on brake support flange (519) of the shaft restraining member.” Id. I agree with these findings.

199. Weaver discloses “[h]ydraulic or mechanically operated friction brakes 518” that “are provided on opposing brake support flanges 519 extending in an essentially axial direction from an end 516 of half-spool member 401” and act to “clamp main shaft 402 and thereby inhibit rotation of shaft 402.” Weaver at [0017].



Weaver, Figure 5

200. Further, in the April 26, 2024 Office Action, the examiner found that it would be obvious to a POSITA to combine Signore with Weaver to result in a “main shaft fixture compris[ing] adjustable pressure mandrels with tap shoes”:

Thus, the manner of enhancing a particular device was made part of the ordinary capabilities of one skilled in the art based upon the teaching of such improvement in Weaver et al. Accordingly, one of ordinary skill in the art would have been capable of applying this known "improvement" technique in the same manner to the prior art of Signore et al and the results would have been predictable to one of ordinary skill in the art, namely, one skilled in the art would have readily recognized that modifying the torque clamps of Signore to be hydraulic or mechanical operated such that its radial position can be adjusted to fit the main shaft with desired friction.

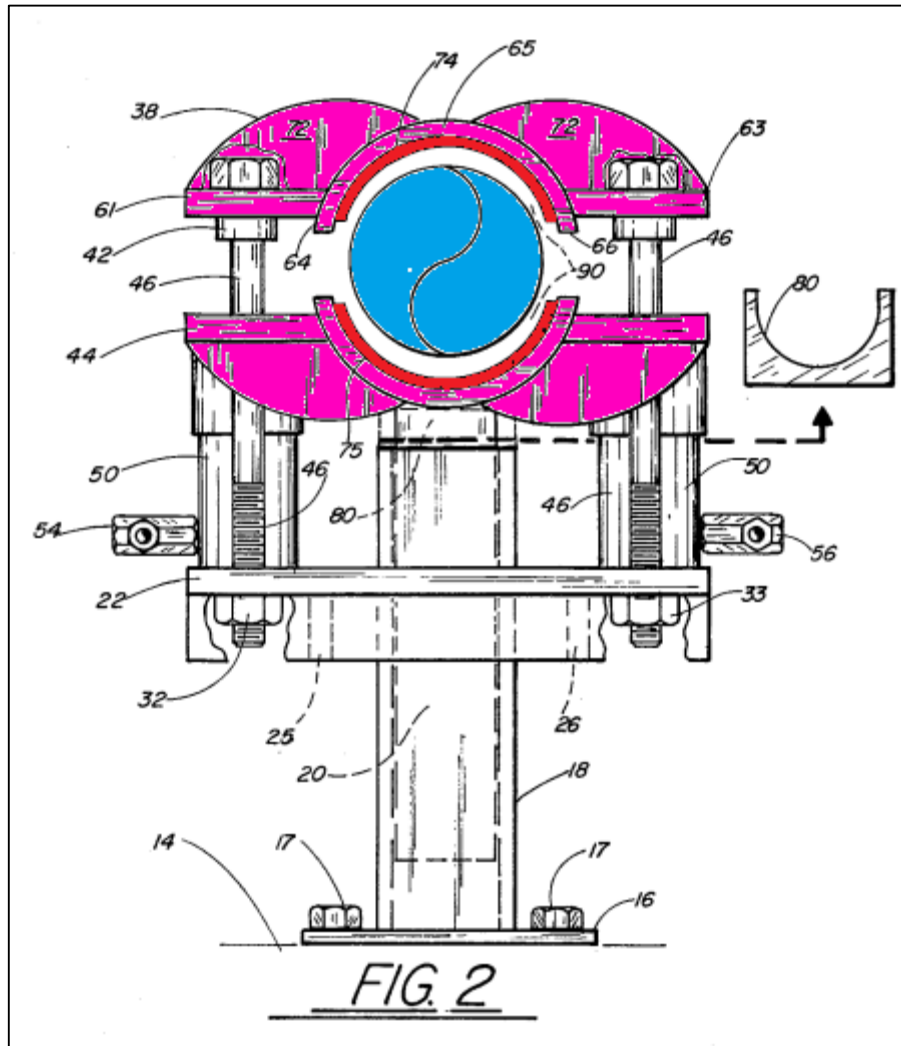
Exhibit 1002, at 88 (April 26, 2024 Non-Final Rejection, at 6). I agree with these findings.

201. In addition, in the prosecution of the '578 Patent, Patent Owner did not dispute that the claimed “main shaft fixture compris[ing] adjustable pressure mandrels with tap shoes” was obvious in view of Signore as modified by Weaver. *See supra*, Section VII.C.

202. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver alone. However, my opinion is bolstered by

the fact that adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft were well known in the art. For example, this is corroborated by the Boudreaux, Schilling, and Fetzer references:

203. **Boudreaux**: Boudreaux discloses a shaft immobilizer used in the energy industry, in particular “[i]n the use of large boats, particularly in crew boats, in servicing the offshore oil and gas industry.” Boudreaux at 1:5-14.



204. More specifically, Boudreaux teaches “immobilizers for propeller shafts and the like” and “a propeller shaft immobilizer apparatus which hydraulically or manually immobilizes the propeller shaft,” which is particularly important “when the engine propelling the shaft becomes inoperative.” *Id.* at 1:6-11. Immobilizing the shaft is necessary in such circumstances because, as explained by Boudreaux, “the propeller beneath the craft, which is operated by the engine, remains exposed to the flow of current since the craft continues to be propelled by the remaining

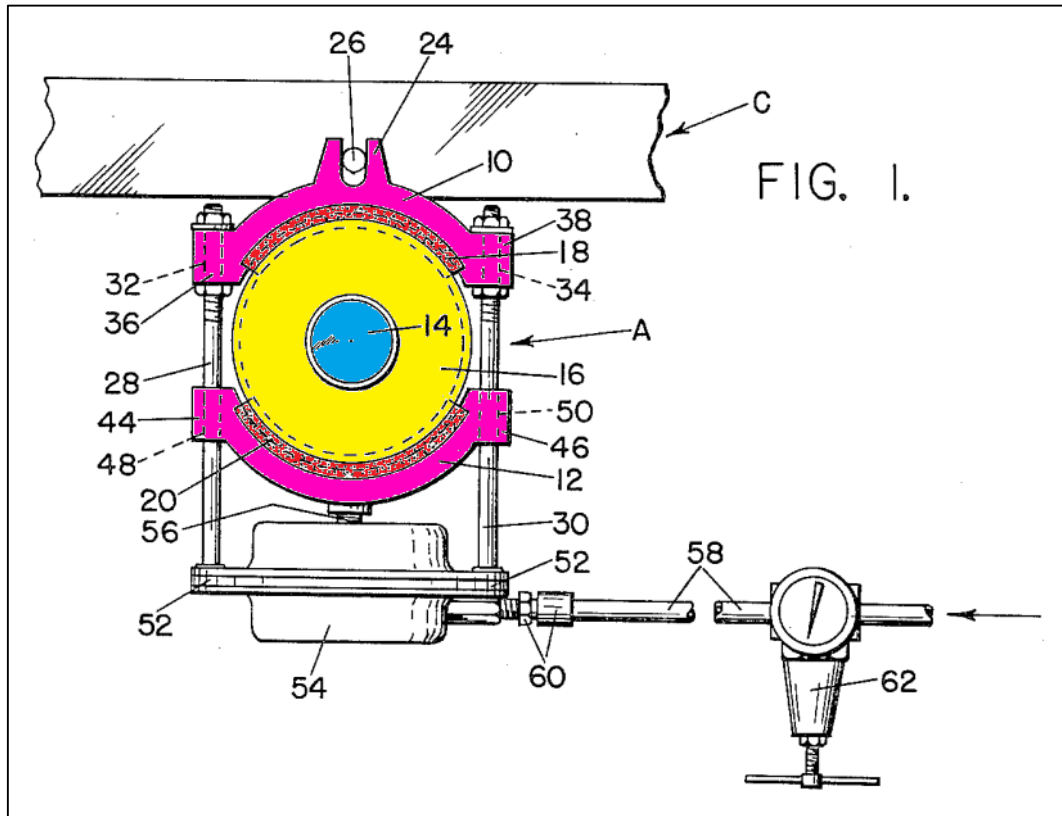
engines.” *Id.* at 1:20-23. In other words, the external forces of the flow of the water current act on “[a] screw-typed propeller, [which,] because of its vaned construction, continues to turn, ... rotating the shaft connected thereto.” *Id.* at 1:23-25. Such forces of the flow of the water current act on a screw-type propeller in much the same way that the flow of the air current acts on the blades on a wind turbine, which rotates a shaft connected thereto.

205. Boudreaux is analogous because, like Signore and Weaver (discussed above, *see supra* ¶ 162), Boudreaux uses friction to inhibit rotation of a shaft where such rotation is caused by flow of a fluid medium over a propellor (wind turbine rotor or ship impellor). *See* Boudreaux at Abstract (“Upper and lower engaging surfaces are movably mounted on the upper base portion and movable by hydraulic power to **frictionally** engage the propeller shaft to be immobilized.”); *id.* at 6:57-63 (“As discussed earlier, there is further provided, on engaging sections 38 and 44, brake friction means 74 and 75 respectively, which are typical brake shoe material as found in automobiles or the like, and serve as a friction surface between engaging sections 44 and 38 and the exterior surface of propeller shaft 11, in order to establish more secure braking.”).

206. Further, like Weaver, Boudreaux teaches using hydraulics to position the friction brakes. *Compare* Weaver [0017] (“**Hydraulic** or mechanically operated friction brakes 518 are provided in some configurations to clamp main shaft 402 and

thereby inhibit rotation of shaft 402.”) *with* Boudreaux at 6:64-7:4 (“In the operation of apparatus 10, once it has been secured and placed, FIGS. 3 and 4 illustrate in side view, the relative movement of engaging sections 38 and 44 during the immobilizing process. **Hydraulic** fluid is injected into hydraulic cylinders 50 as is illustrated by line 84 in FIG. 4. Upper engaging section 38 is forced to move downward (arrow 85) against the pressure until brake friction means 74 makes friction contact with the upper 1/2 circumferential surface of propeller shaft 11.”).

207. **Schilling**: Schilling’s friction brake comprises a set of symmetrically arranged mandrels with brake shoes [(pink in Schilling Figure 1 below)] with heat resistant liners [(red in Schilling Figure 1 below)] to engage a roller [(yellow in Schilling Figure 1 below)], or a stub shaft 14 [(blue in Schilling Figure 1 below)] of the roller where the amount of engagement/friction can be adjusted with air or fluid in a bladder (*e.g.*, hydraulic fluid).

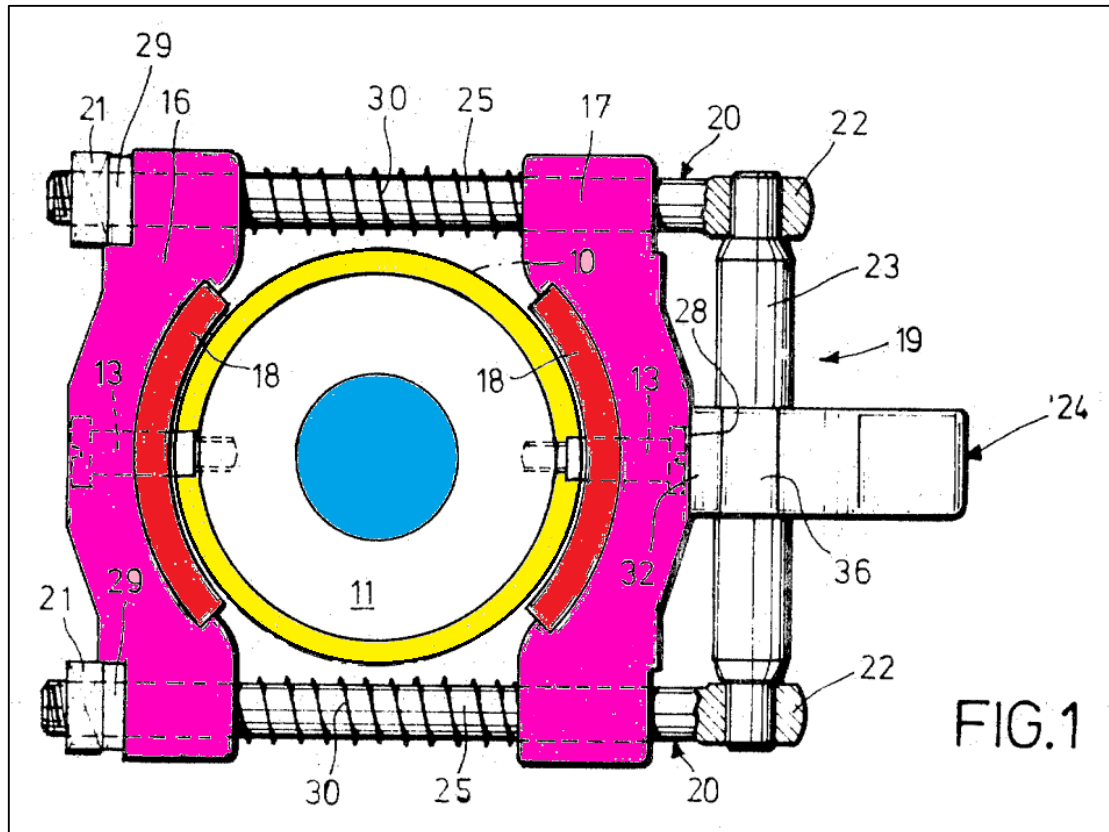


Schilling, Figure 1 (annotated).

208. More specifically, Schilling discloses “a friction brake adapted to be readily installed on an exposed end of a shaft, or upon a drum or similar rotatable member and which is actuated by air or another suitable fluid through the use of a conventional diaphragm.” *Id.* at 1:29-34. The pressure applied by the brake is adjusted by the use of a control valve 62. *See id.* at 3:27-31; *see also id.* at 1:51-57.

209. **Fetzer:** Fetzer discloses a brake comprising a set of two mandrels with tap shoes where the brakes can be engaged/applied using a lever. The friction brake of Fetzer “includes a manually operable pivotable brake lever to draw towards one

another two brake shoes [(pink in Fetzer Figure 1 below)] for engaging an interposed spindle to be braked.” Fetzer at Abstract.

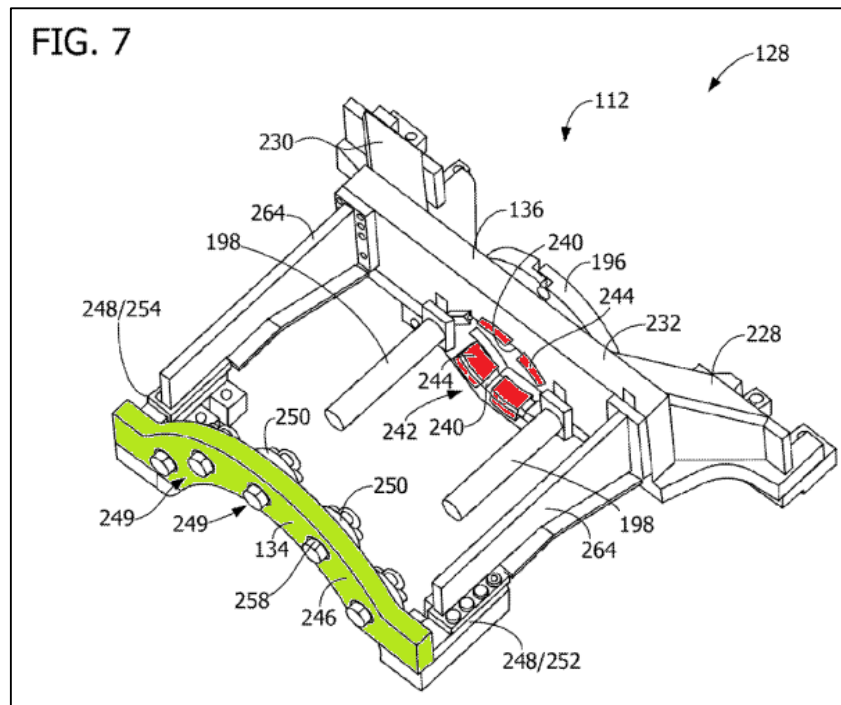


Fetzer, Figure 1 (annotated).

210. When the pivotable brake lever is operated, “nuts 21 serve to displace the first brake shoe 16 [(pink in Fetzer Figure 1 above)] towards the friction face 10 [(yellow in Fetzer Figure 1 above)] and further serve for setting the magnitude of the braking force in the stable position 34 of the lever 24. Between each nut 21 and an adjacent portion of the first brake shoe 16 there is provided an elastic disc 29. Between the two brake shoes 16 and 17 [(pink in Fetzer Figure 1 above)] each bar 20 is surrounded by a biased compression spring 30 which continuously urges the

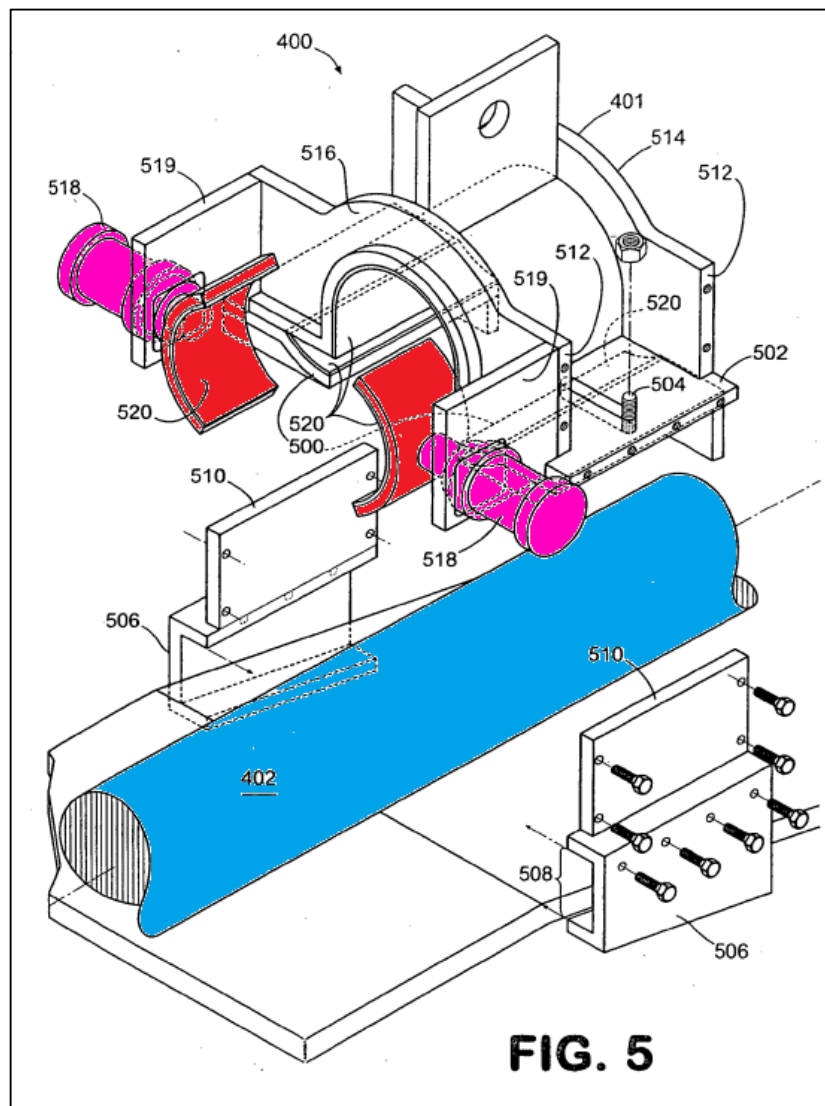
- d. 1[c]: “and the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft”

212. Signore discloses “a plurality of torque clamps 244 are coupled to interior surfaces 240, and are oriented circumferentially about opening 242. Each torque clamp 244 is configured to facilitate coupling restraint assembly 136 to drive shaft 24 via a friction fit to facilitate limiting a movement of drive shaft 24.” Signore at [0053].



Declaration of John Bosche in Support of Petition for
Inter Partes Review of U.S. Pat. No. 12,104,578
Signore Application, Figure 7

213. Weaver discloses “[h]ydraulic or mechanically operated friction brakes 518” that “are provided on opposing brake support flanges 519 extending in an essentially axial direction from an end 516 of half-spool member 401” and act to “clamp main shaft 402 and thereby inhibit rotation of shaft 402.” Weaver, [0017].



Weaver, Figure 5

214. Further, in the April 26, 2024 Office Action, the examiner found that it would be obvious to a POSITA to combine Signore with Weaver to result in “the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft”:

Thus, the manner of enhancing a particular device was made part of the ordinary capabilities of one skilled in the art based upon the teaching of such improvement in Weaver et al. Accordingly, one of ordinary skill in the art would have been capable of applying this known "improvement" technique in the same manner to the prior art of Signore et al and the results would have been predictable to one of ordinary skill in the art, namely, ***one skilled in the art would have readily recognized that modifying the torque clamps of Signore to be hydraulic or mechanical operated such that its radial position can be adjusted to fit the main shaft with desired friction.***

Exhibit 1002, at 88 (April 26, 2024 Non-Final Rejection, at 6). I agree with these findings.

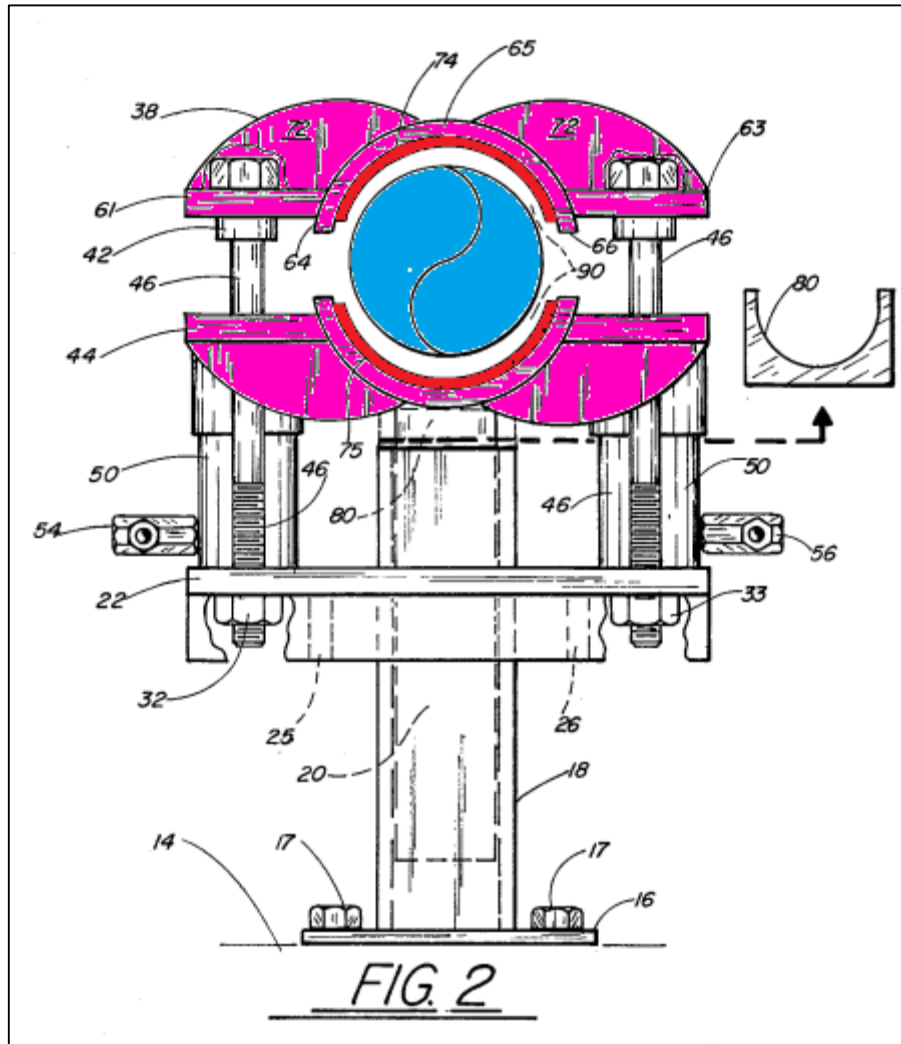
215. To the extent that either of Weaver or Signore does not explicitly disclose that Weaver’s hydraulic or mechanically operated friction brakes 518 or that Signore’s torque clamps 244 can be configured at *either* “a *passive* position” or

“an *active* position,” it would be obvious to a POSITA that the torque clamps would be operated between passive and active positions to selectively restrain or release the main shaft as various steps of a maintenance activity are performed (for example, releasing the torque clamps to adjust the rotor position to a desired angle and then engaging the torque clamps to restrain the shaft while a gearbox or bearing is replaced).

216. In addition, in the prosecution of the '578 Patent, Patent Owner did not dispute that the claimed “adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft” was obvious in view of Signore as modified by Weaver. *See supra* Section VII.C.

217. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver alone. However, my opinion is bolstered by the fact that adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft were well known in the art. For example, this is corroborated by the Boudreaux, Schilling, and Fetzer references:

218. **Boudreaux**: Boudreaux discloses a shaft immobilizer used in the energy industry, in particular “[i]n the use of large boats, particularly in crew boats, in servicing the offshore oil and gas industry.” Boudreaux at 1:5-14.



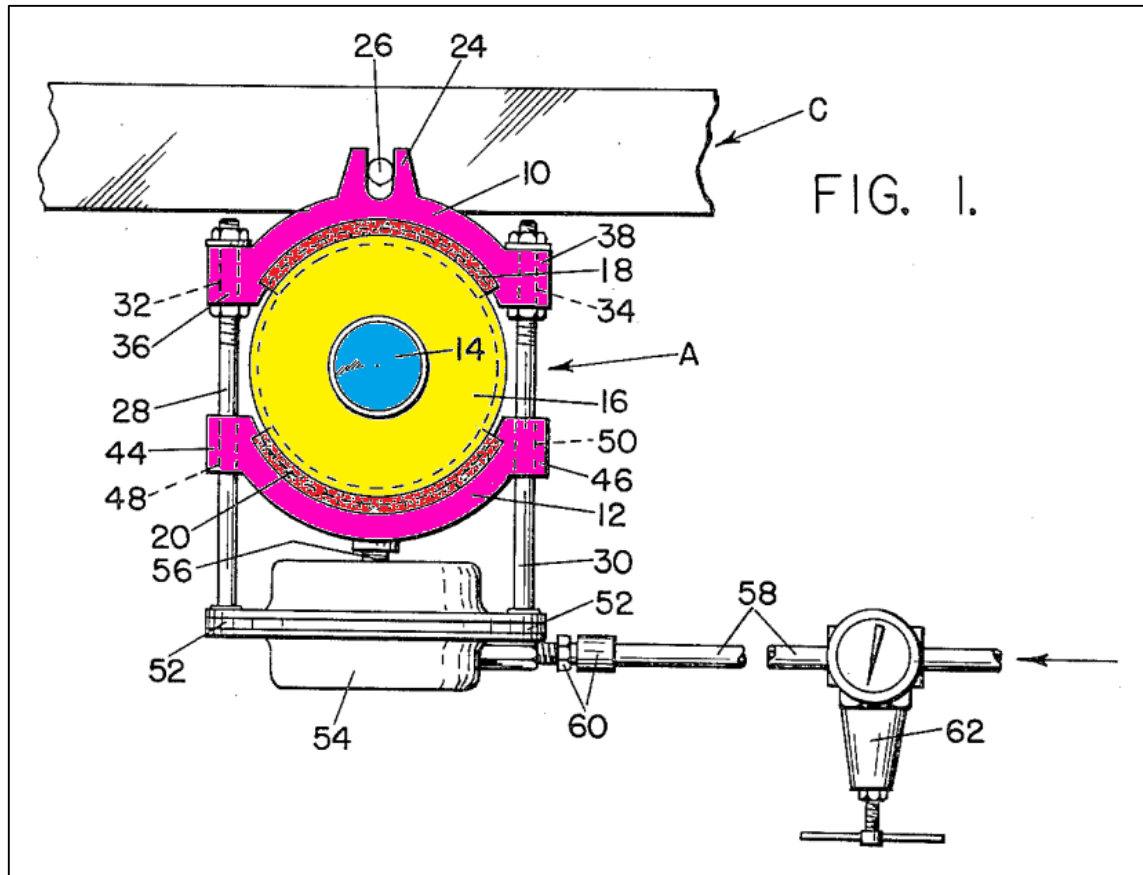
219. Boudreaux discloses hydraulic valves that can be used to maintain the upper and lower engaging sections either in contact with the shaft, or in a position away from the shaft. When the valve handles are in a closed position, “the hydraulic

fluid between valve 69 and hydraulic cylinders 50 [is maintained] in the constant pressurized state, and therefore ***maintain apparatus 10 in the closed position around propeller shaft 11***. Likewise ***in order to free propeller shaft 11, valve 62A is open***, and the hydraulic pressure is therefore relieved, and lower section 44 drops back into place against the upper portion of mounting post 18, and upper section 38 is moved upward due to the expansion of springs within hydraulic cylinders 50, thus ***providing 1/2 inch clearance space 90 for clear rotation of shaft 11 during use.***”
Id. at 7:14-29.

220. In the event that hydraulic pressure is not available, Boudreaux discloses manual activation of the propeller shaft immobilizer apparatus by the use of threaded bolts: “In order to manually set the apparatus in frictional engagement with shaft 11, the head of bolts 28 through 31 are rotated by a wrench or the like, which would cause bolts 28 through 31, since they are threaded through the floor 22 of apparatus 10, would lower the upper engaging section 38 and frictional engagement with shaft 11, and likewise raise lower engaging section 44 in frictional engagement, as seen in FIG. 4.” *Id.* at 7:58-8:10.

221. **Schilling:** Schilling’s friction brake comprises a set of symmetrically arranged mandrels with brake shoes [(pink in Schilling Figure 1 below)] with heat resistant liners [(red in Schilling Figure 1 below)] to engage a roller [(yellow in Schilling Figure 1 below)], or a stub shaft 14 [(blue in Schilling Figure 1 below)] of

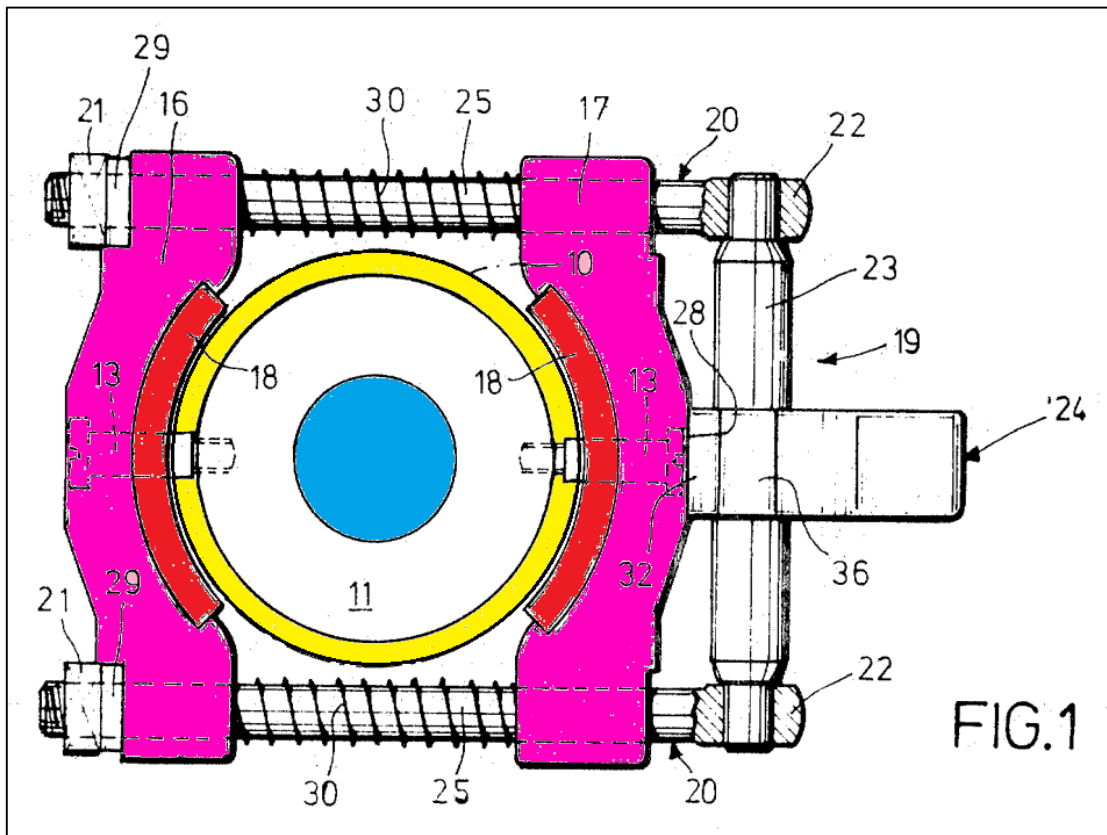
the roller where the amount of engagement/friction can be adjusted with air or fluid in a bladder (*e.g.*, hydraulic fluid).



Schilling, Figure 1 (annotated).

222. More specifically, Schilling discloses “a friction brake adapted to be readily installed on an exposed end of a shaft, or upon a drum or similar rotatable member and which is actuated by air or another suitable fluid through the use of a conventional diaphragm.” *Id.* at 1:29-34. The pressure applied by the brake is adjusted by the use of a control valve 62. *See id.* at 3:27-31; *see also id.* at 1:51-57.

223. **Fetzer:** When the pivotable brake lever of Fetzer is operated, “nuts 21 serve to displace the first brake shoe 16 [(pink in Fetzer Figure 1 below)] towards the friction face 10 [(yellow in Fetzer Figure 1 below)] and further serve for setting the magnitude of the braking force in the stable position 34 of the lever 24. Between each nut 21 and an adjacent portion of the first brake shoe 16 there is provided an elastic disc 29. Between the two brake shoes 16 and 17 [(pink in Fetzer Figure 1 below)] *each bar 20 is surrounded by a biased compression spring 30 which continuously urges the two brake shoes 16, 17 into positions in which they are disengaged from the brake face 10 of the spindle.”* *Id.* at 2:45-59.



Fetzer, Figure 1 (annotated).

- e. **1[d]: “and in that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.”**

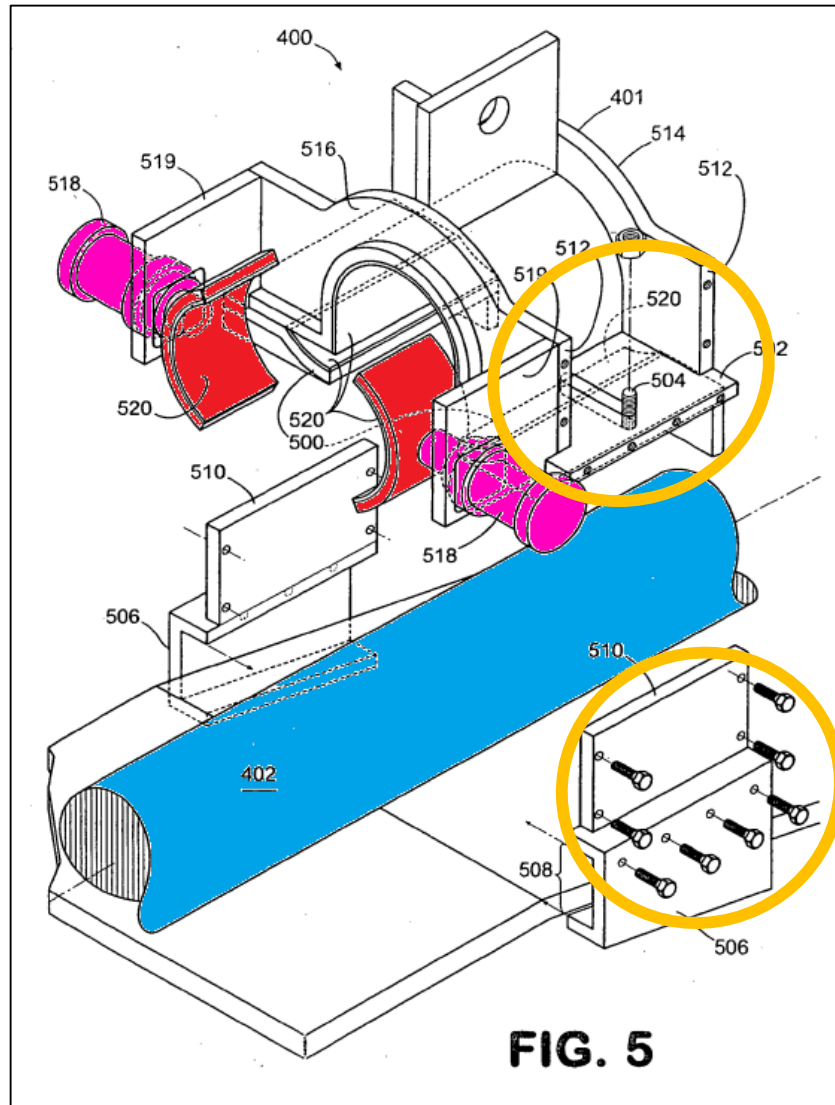
224. This element is taught by Signore and Weaver and further in view of Power Climber, Holloway, and/or Stegemann.

225. The specification of the '578 Patent discloses two types of cranes in or on a nacelle, “self-hoisting” cranes and “lightweight” cranes. See '578 Patent, 2:34-43 (describing the “main shaft fixture comprising ... *mounting facilities* to be engaged *for a lightweight crane*”), 2:56-60 (“With the intent of being able to use a self-hoisting crane with a ground-based winch together with the main shaft fixture according to the invention, it may *comprise mounting facilities* for a *self-hoisting crane* whose winch is placed on the ground surface ground near the foot of the wind turbine.”). Element 1[d] does not limit the claimed mounting facilities for use with any particular type of crane, including for use with either a lightweight crane or a self-hoisting crane. As such, mounting facilities for any crane meets this limitation. Furthermore, the claim does not limit the mounting facilities to be the *sole* mounting point for a crane, and so a crane that is partially supported by a different structure and partially supported by a mounting facility on the main shaft fixture also meets this limitation. Moreover, the claimed element is not required to support the weight of a crane or to provide any other specific mounting characteristics.

226. Further, the '578 Patent does not limit what type of mounting facilities must be provided. For example, attachment plates, lifting eyes, or a means for securing cables or chains may all be mounting means. As such, this element 1[d] is not limited to any specific type of mounting facility.

227. Signore discloses mounting facilities in the nacelle for either a lightweight crane or a self-hoisting crane. In the April 26, 2024 Office Action, the examiner found that the Signore Application discloses a “main shaft fixture further compris[ing] mounting facilities for a self-hoisting crane having [a] winch located on a ground surface near a foot of the wind turbine,” and that “the structure of the main shaft fixture is capable for mounting with a self-hoisting crane, such as by using a chain or a cable connected between the crane and the main shaft fixture.” Exhibit 1002, at 88 (April 26, 2024 Non-Final Rejection, at 6). I agree with these findings.

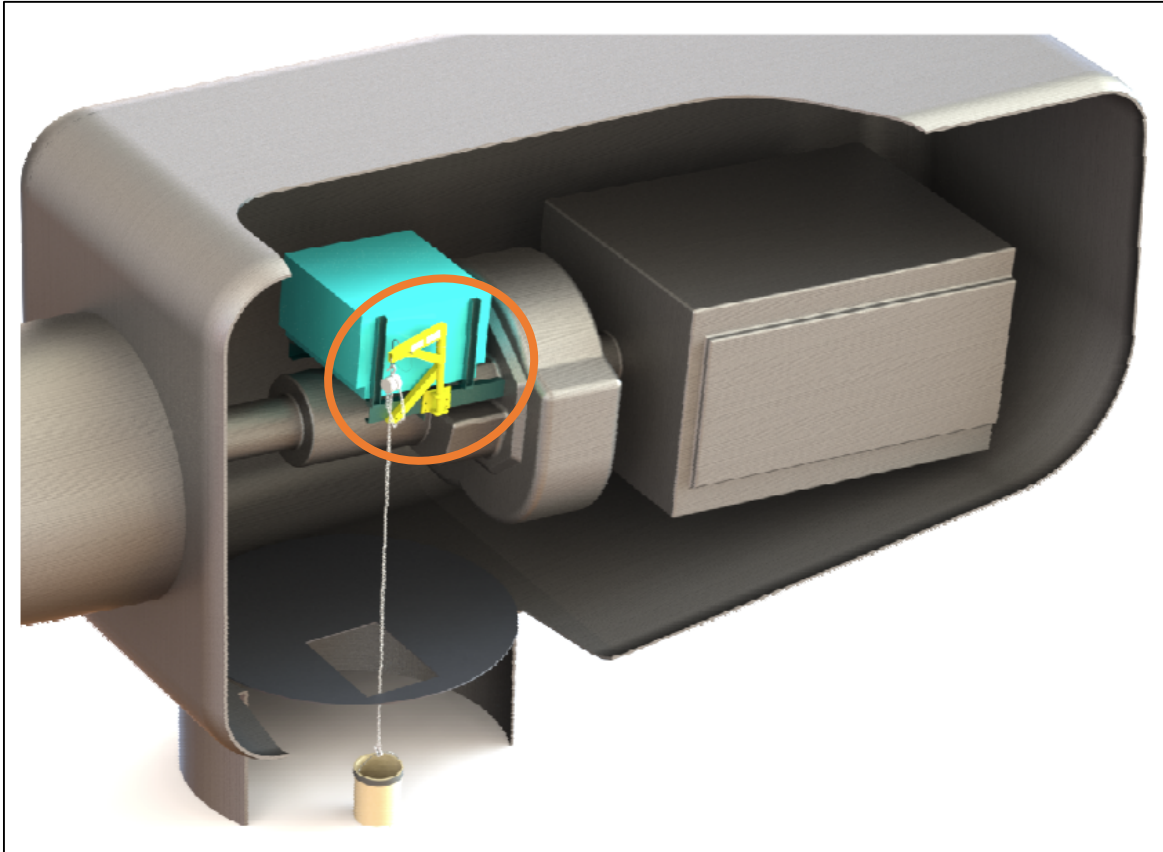
228. To the extent that Signore does not disclose a “main shaft fixture further compris[ing] mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine,” Weaver provides sufficient mounting facilities for a crane, such as on mounting wings 502, stiffening plates 510, channel clamp 506, or U-shaped channel 508 (502, 510, 506, and 508, indicated in orange in Weaver Figure 5 below) all of which are in the nacelle when Weaver’s main shaft fixture is installed in a wind turbine.



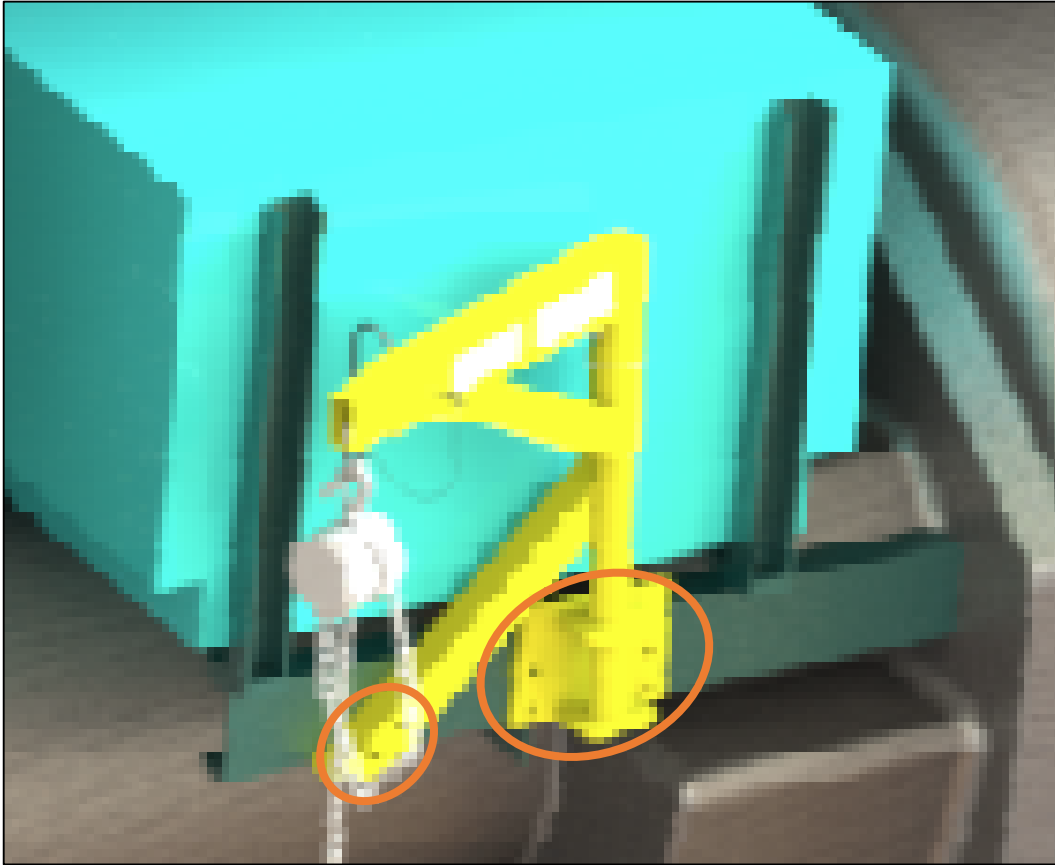
229. To the extent that the combination of Signore and Weaver does not disclose the claimed mounting facilities on a main shaft fixture that are adapted for anchoring a crane on/in a nacelle of a wind turbine, Power Climber, Holloway, and/or Stegemann discloses this element.

230. Power Climber discloses a lightweight Nacelle Davit lifting device (crane) that “has the ability to retrofit to any 1.5 MW gearbox, and installs in just under an hour” and features “a 250-lb capacity and optional chain or electric hoist.”

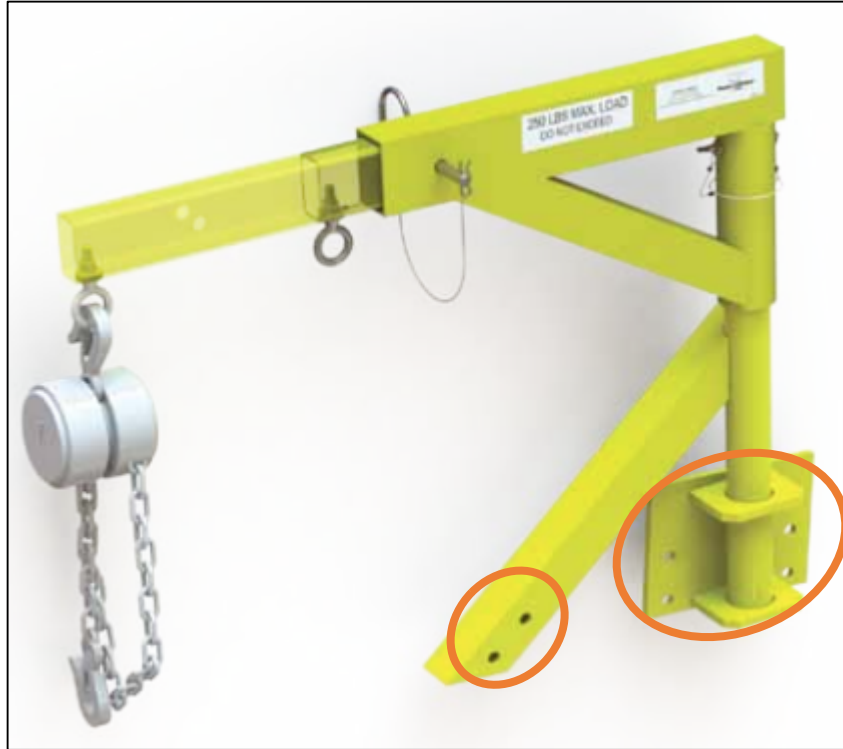
See Ex. 1023. In addition, Power Climber depicts the Power Climber Wind Nacelle Davit (yellow) mounted to a main shaft fixture (green) in a wind turbine.



231. The figure in Power Climber depicts the Nacelle Davit mounted to the main shaft fixture via a mounting plate with holes, *e.g.*, for mounting bolts. For example, the mounting plate of the Nacelle Davit can be clearly seen in an enlarged view of Power Climber's figure:



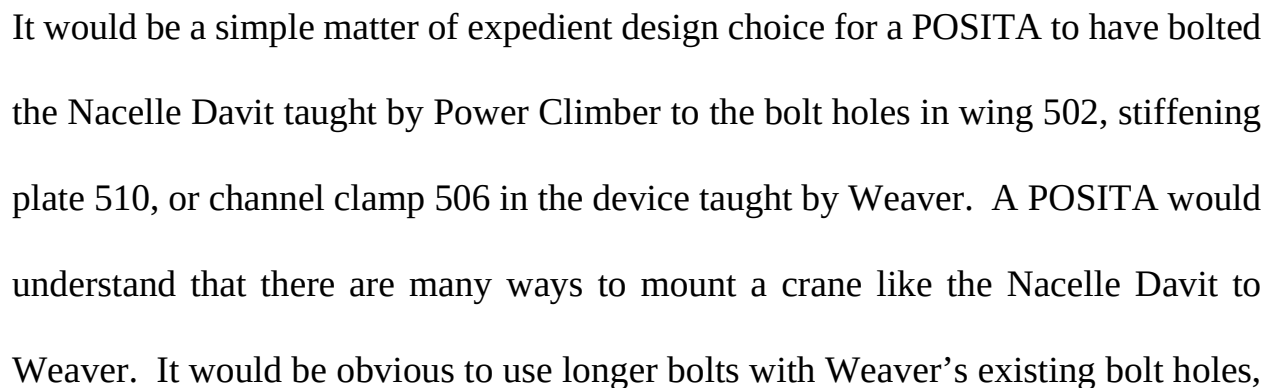
232. The disclosure of the mounting facilities on the main shaft fixture / Nacelle Davit is corroborated by the August 8, 2012 Power Climber Brochure (Ex. 1027). The Power Climber Brochure discloses that the Nacelle Davit is configured to be mounted on a main shaft fixture of a “any GE 1.5 turbine nacelle.” See Ex. 1027. The Power Climber Brochure clearly depicts the mounting plate of the Nacelle Davit with holes, *e.g.*, for mounting bolts.



233. Further, the Power Climber Brochure discloses that the Power Climber Wind Nacelle Davit is “simple to install,” has a load capacity of 250 lbs., weighs just 37 lbs., and has a “[h]eaviest [s]ingle [p]iece that weighs just 19 lbs. *Id.* at 1, 2. In addition, the Power Climber Brochure corroborates Power Climber’s intended use of the Nacelle Davit, depicting the Power Climber Wind Nacelle Davit (yellow) mounted to a main shaft fixture (green) in a wind turbine.

234. Weaver discloses that the oil cooler 302 is removed so that it won’t “interfere with the installation of a shaft-restraining collar” (*i.e.* a main shaft fixture). A POSITA would understand that it would be advantageous to provide mounting points that do not depend on the presence of an oil cooler, and that wing 502, stiffening plate 510, or channel clamp 506 depicted in Figure 5 of Weaver (each of

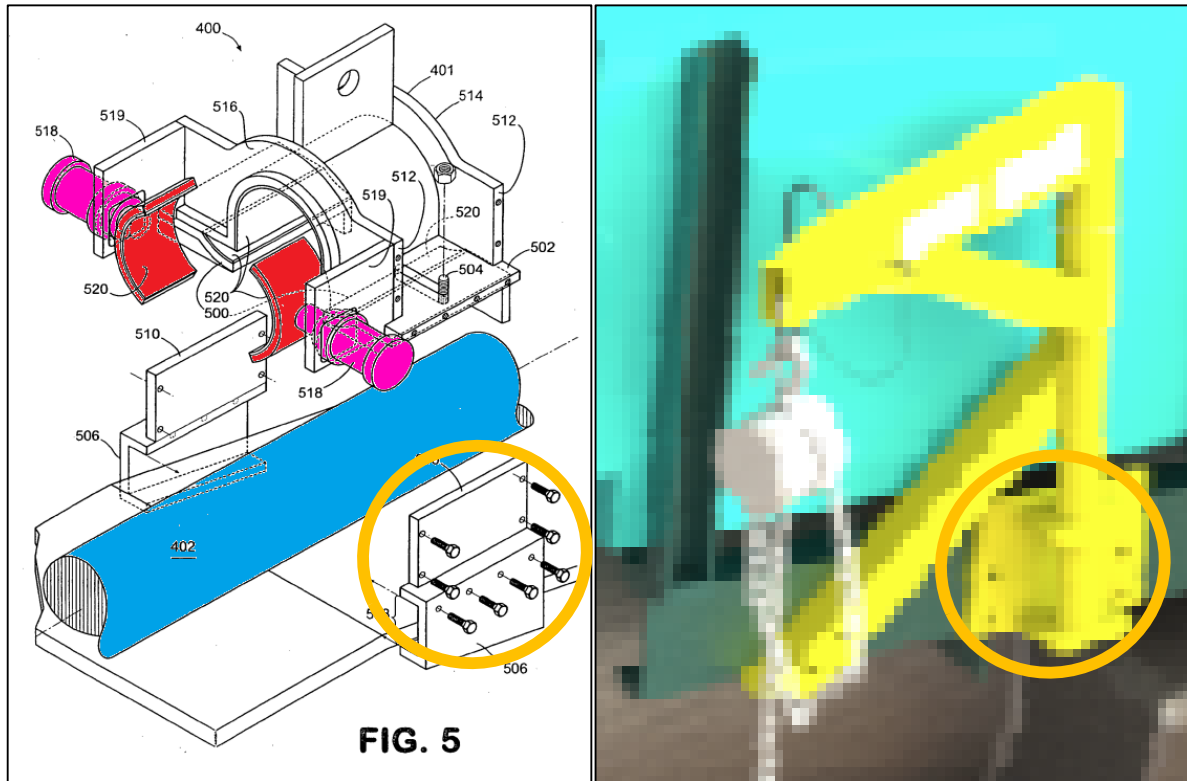
which contain bolt holes, depicted in orange below) would make a logical mounting location for the Nacelle Davit taught by Power Climber, either with or without an installed oil cooler.



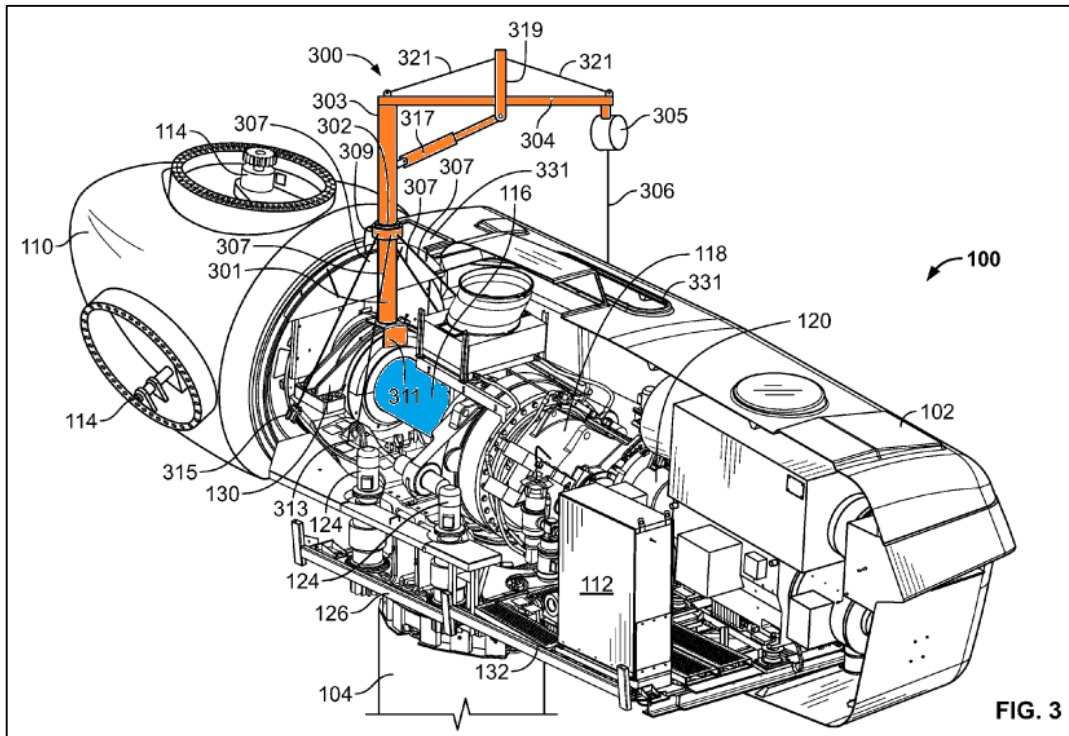
Declaration of John Bosche in Support of Petition for
Inter Partes Review of U.S. Pat. No. 12,104,578

to create additional bolt holes, or to employ other methods of attachment well known to a POSITA.

235. In light of Power Climber, it would be obvious to a POSITA to provide mounting facilities, including facilities for mounting bolts, on the main shaft fixture in the nacelle of Signore and Weaver for use as “mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.” For example, compare Figure 5 of Weaver with the Nacelle Davit of Power Climber:



236. Alternatively, Stegemann discloses a lightweight crane mounted to a wind turbine component in the nacelle.



237. Stegemann discloses a crane assembly 300 (orange in Stegemann Figure 3 above). Stegemann also discloses that “[t]he individual components of the first crane assembly 300 ... preferably do not exceed about 30 kg and are sufficiently lightweight and sufficiently small to be handled manually. More specifically, the components of the first crane assembly 300 ... would be sufficiently disassemblable to permit the individual components to be carried by hand.” Stegemann at [0046].

238. In addition, Stegemann discloses that “[t]he first primary support member 301 is attached to the wind turbine by attachment plate 311,” which is “configured to mate, attach or otherwise fasten to a component of the wind turbine

100.” *Id.* at [0039]. Further, Stegemann discloses that “[w]hile not so limited, the attachment plate 311 may attach to or replace existing components, and utilize existing fastening locations.” *Id.*

239. In addition, Stegemann discloses additional, “secondary support members 307 [which] may be a bar, wire, cable, rope, chain, strap or any other elongated device capable of supporting the first and second primary support members 301, 303.” *Id.* at [0040]. Such secondary support members may be anchored to “secondary support clamps 315 [which] may be clamped or otherwise fastened to *lips, features or surfaces within the wind turbine 100 that provide a desired angle providing support for the first and second primary support members 301, 303.*” *Id.*

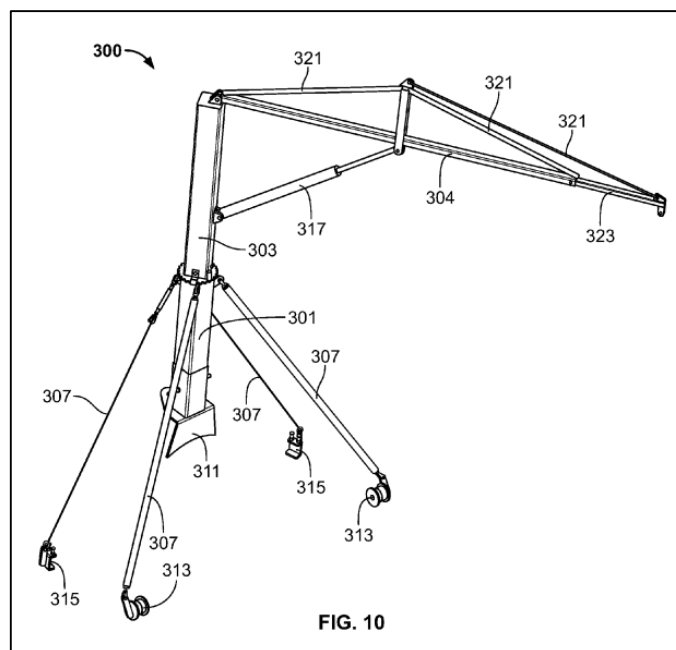
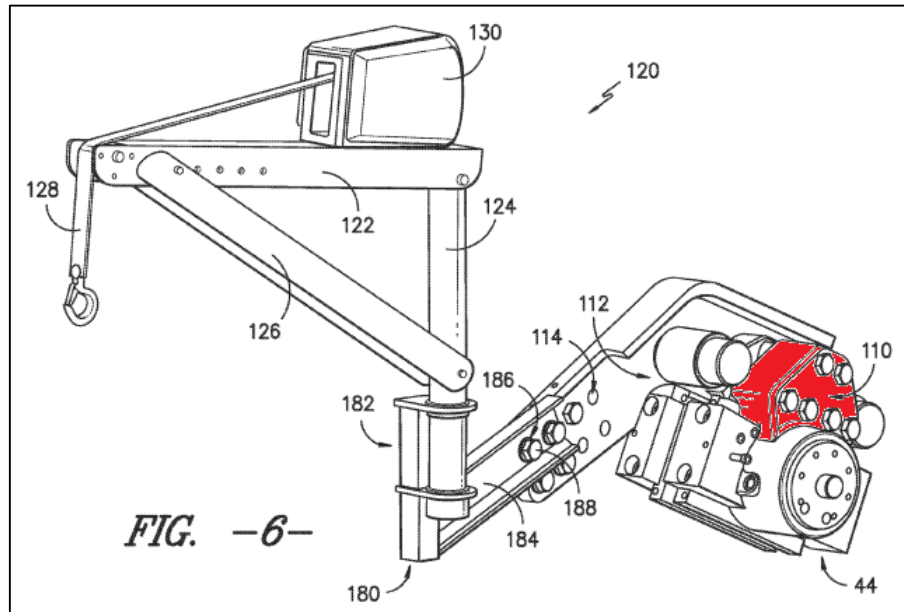


FIG. 10

240. Attaching any of these secondary support members to the main shaft fixture would satisfy the requirement of claims 1, 15, and 16 that the main shaft “further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.” Since the ’578 Patent does not provide detailed information about the “facilities adapted for anchoring a crane,” any type of support or brace for a crane would serve as appropriate mounting facilities. Therefore, any of Stegemann’s supports, if attached to the main frame fixture as an example of a “lip, feature, or surface” within the wind turbine, as taught by Stegemann, serve as appropriate mounting facilities.

241. In light of Stegemann, it would be obvious to a POSITA to provide mounting facilities, including, *e.g.*, lips, features, or surfaces, on the main shaft fixture in the nacelle of Signore and Weaver for use as “mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine,” including mounting facilities for securing cables or chains.

242. Alternatively, Holloway discloses mounting a portable crane to various areas or parts of a wind turbine, including to the bedplate of the nacelle or to a brake caliper used to arrest the rotor or to the housing of the main shaft.



243. More specifically, Holloway discloses “a mount assembly 180 for use with a brake caliper 110 [(red in Holloway Figure 6 above)] of a gearbox 44” Holloway at 7:3-4. In the brake caliper-mount embodiment, “[s]upport shaft 124 [of the crane] may be rotatably mounted” via hinge portion 182, a flange 184, “which may abut again flange 112 of the brake caliper 110.” *Id.* at 7:5-9. Fasteners, such as bolts, then “couple[e] the flange 184 and mount assembly 180 in general to the brake caliper 110....” *Id.* at 7:9-13. Holloway discloses that the possible mount assemblies are not limited, and that “mount assemblies may be utilized to detachably mount the crane 120 to various other suitable wind turbine 10 components. For example, ***the crane 120 may be mounted through use of a suitable mount assembly to... the main shaft 40, a main bearing,*** etc.” *Id.* at 7:20-32. Holloway further discloses that “[a]ttachment of any of the various suitable mount assemblies through,

for example, ***suitable bolting, clamping, or other mounting techniques*** are within the scope and spirit of the present disclosure.” *Id.* at 7:36-39. Holloway further discloses that the mount assembly “may further include a mount assembly that can be modified for use in mounting a crane 120 to two different wind turbine 10 components, or any other suitable mounting means.” *Id.* at 7:40-48.

244. It is clear from the teachings of Power Climber, Stegemann, and/or Holloway that the selection of a crane mounting location in the nacelle of a wind turbine is a design choice within the ability of a POSITA. Using the main shaft fixture does not provide surprising or unexpected benefits compared to any other mounting location within the nacelle. Therefore, selecting a mounting location on the main shaft fixture would be an obvious matter of design choice. Furthermore, using the main shaft fixture as a crane mounting location in the nacelle provides an expedient advantage that it is a consistent and standard mounting position that does not vary from wind turbine to wind turbine, as would have been obvious to a POSITA at the relevant time period.

245. A POSITA would have found it obvious as of the priority date of the ’578 Patent to include “mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine” in the main shaft fixture of Signore or Weaver. For example, a POSITA would have found it obvious to use mounting facilities adapted to anchor the cranes disclosed by Power Climber, Stegemann, and/or Holloway.

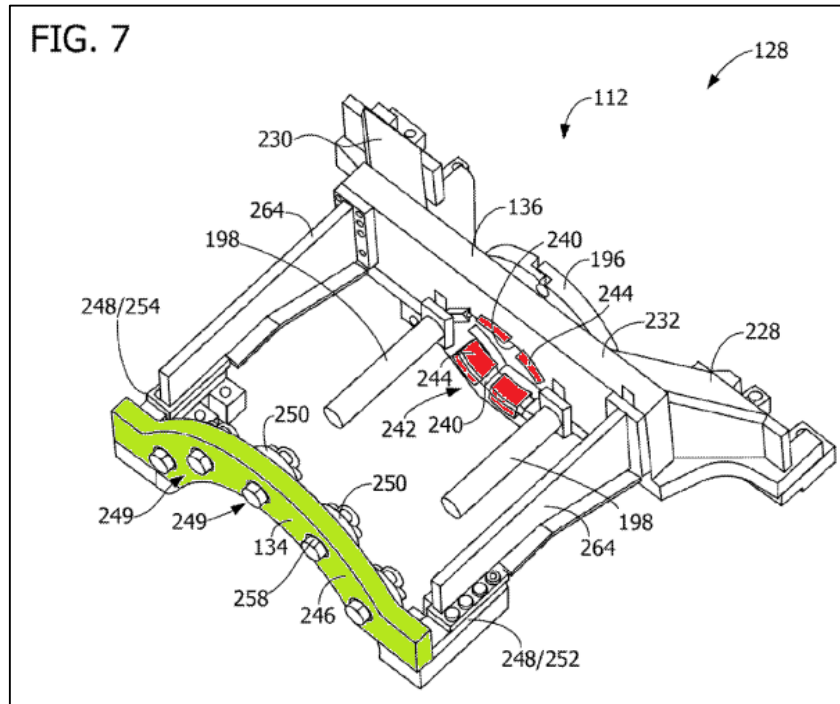
246. In light of the foregoing discussion, the elements of Claim 1 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

6. **Claim 2: “Main shaft fixture according to claim 1, characterized in that the adjustable pressure mandrels with tap shoes comprise at least three radial displaceable pressure mandrels, substantially symmetrical[ly] located around a centre axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes”**

247. The main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann. *See supra* Section XII.A.5.

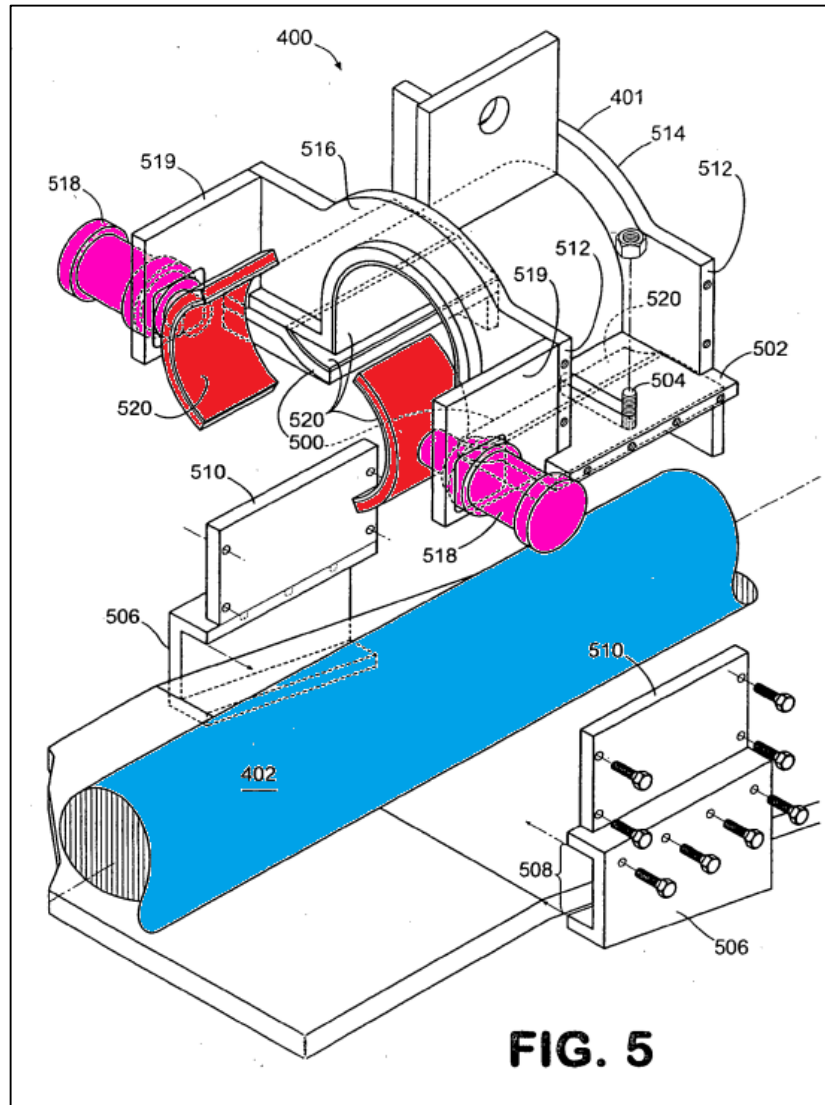
248. Signore in view of Weaver teaches at least three radially displaceable pressure mandrels, substantially symmetrically located around a centre axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes. *See supra* Section XII.A.5.c.

249. Signore discloses “a plurality of torque clamps 244” (red in Signore Figure 7 below), that are arranged radially around the center axis of the main shaft, “and are oriented circumferentially about opening 242. Each torque clamp 244 is configured to facilitate coupling restraint assembly 136 to drive shaft 24 via a friction fit to facilitate limiting a movement of drive shaft 24.” Signore at [0053]. As seen below, Figure 7 of Signore shows four torque clamps:



Signore Application, Figure 7

250. In addition, Weaver discloses radially displaceable “[h]ydraulic or mechanically operated friction brakes 518” that “are provided on opposing brake support flanges 519 extending in an essentially axial direction from an end 516 of half-spool member 401” and act to “clamp main shaft 402 and thereby inhibit rotation of shaft 402.” Weaver at [0017]



Weaver, Figure 5

251. Further, in view of Signore's four torque clamps, a POSITA would find it obvious to use at least three radially displaceable friction brakes in Signore in view of Weaver because the radially displaceable friction brakes taught by Weaver as modified to include at least three radially displaceable friction brakes would have been recognized by a POSITA at the relevant time period as providing a more secure and more adjustable attachment point for securing the main shaft. This is

particularly true to better adapt to shafts of varying geometries. The use of at least three mandrels provide the advantage of more readily adapting to main shafts of different diameters, or with different shaft geometries. If only two mandrels are utilized, they must be perfectly aligned in diametric opposition on the main shaft, and at the precise height of the main shaft centerline. By using three mandrels, the friction brakes and mandrels are more easily adjusted to provide a secure hold on the main shaft even if the shaft diameter or shaft height is not exactly what was expected. Moreover, selecting the number and locations of torque clamps or friction brakes would be a matter of design decision for a POSITA.

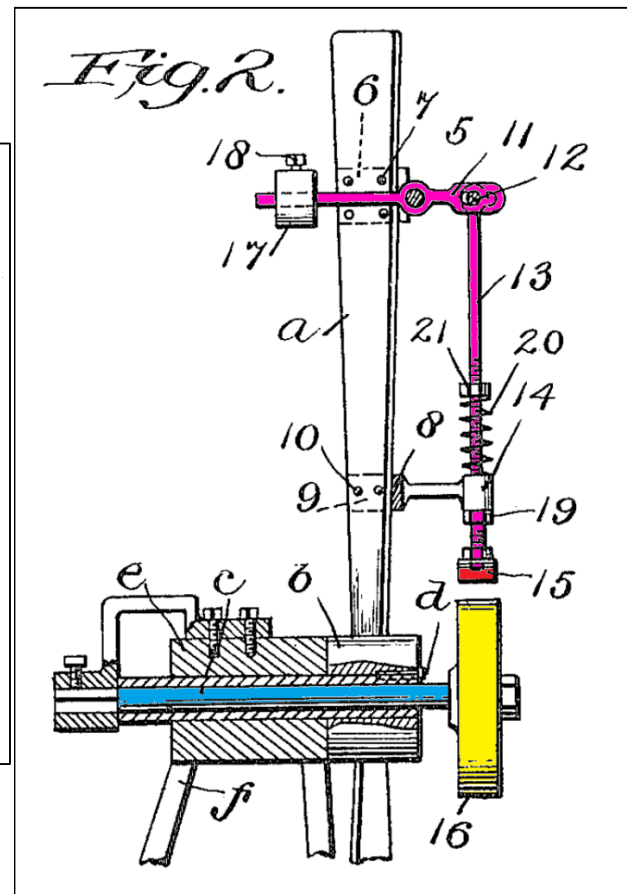
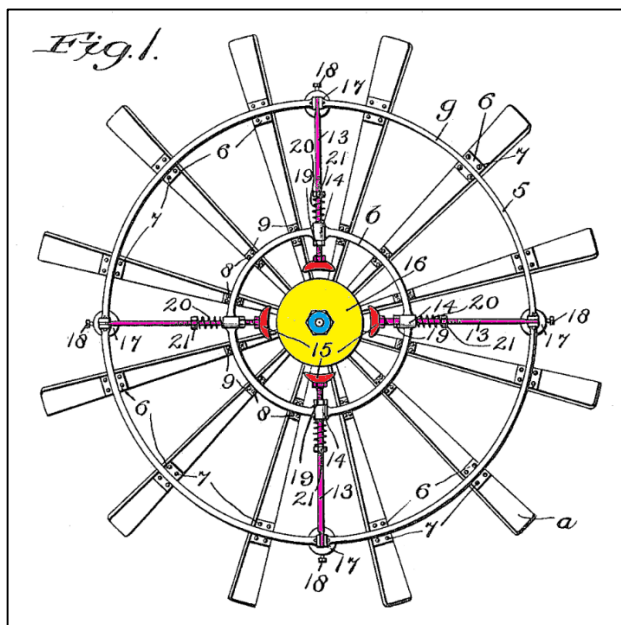
252. In addition, in an April 26, 2024 Office Action, the examiner found that “As to claim[] ... 2,” “[t]he shaft restraining member [of Weaver] includes hydraulic or mechanic[ally] operated friction brakes (518). The clamping action of brakes (518) resists torque from rotor shaft (402). The hydraulic or mechanic brake comprises cylinders supported on brake support flange (519) of the shaft restraining member.” Exhibit 1002, at 88 (April 26, 2024 Non-Final Rejection, at 6). I agree.

253. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver alone.

254. However, my opinion is bolstered by the fact that at least three radially displaceable pressure mandrels, substantially symmetrical located around a center axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft

being furnished with the tap shoes were well known in the art. For example, this is corroborated by Bisbee and Hanxing:

255. **Bisbee**: Bisbee discloses a windmill brake comprising four pressure mandrels with tap shoes symmetrically arranged around a friction disc on the drive shaft.



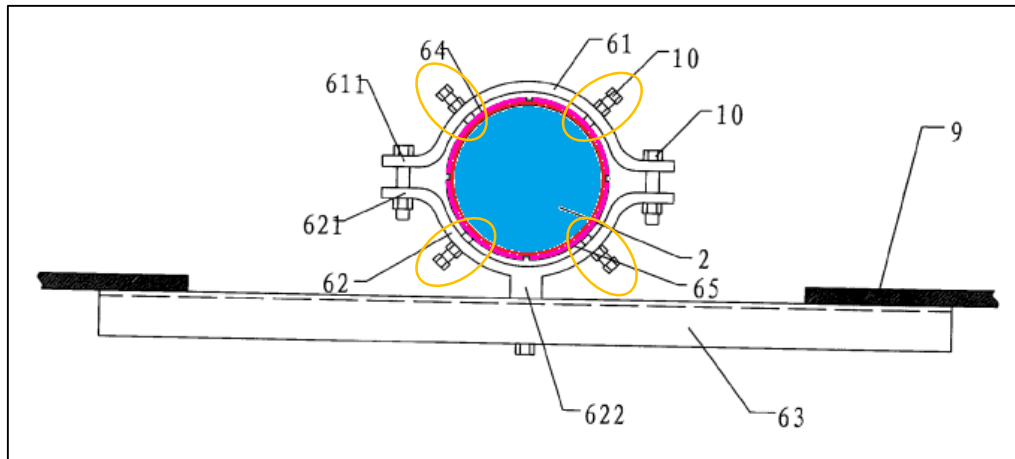
Bisbee, Figures 1 and 2 (annotated).

256. More specifically, Bisbee discloses “[a] series of levers 11 [(pink in Bisbee Figures 1 and 2 above)] are fulcrumed on the annulus 5 and between the blades a. The ends of these levers are suitably connected such as by pin and slot

connections 12, to the outer ends of rods 13, which rods are slidably fitted in guides 14 carried by the inner annulus 8 and have at their inner ends friction shoes 15 [(red in Bisbee Figures 1 and 2 above)] arranged in the plane of a friction disk 16 [(pink in Bisbee Figures 1 and 2 above)] located concentrically at one end of the drive shaft c [(blue in Bisbee Figures 1 and 2 above)].” Bisbee at 1:53-67. “Weights 17 on the power ends of the levers 11, operate to move the levers and rods, whereby, to effect frictional contact between the shoes and disk when the weights move outwardly under centrifugal force attained by the rotation of the propeller.” *Id.* at 1:67-79.

257. It would have been well known to a POSITA that application of a friction force from torque clamps or friction brakes as taught by Signore or Weaver would result in the application of a radial force to the main shaft. This radial force creates a bending moment on the main shaft. Such a radial force and bending moment can damage the main shaft or other components of the wind turbine unless balanced by an equal and opposing force. Selecting the number and locations of torque clamps or friction brakes would be a matter of design decision, and a POSITA would have recognized that well known devices like those taught by Bisbee provide a set of equally spaced and equal but opposite forces on the main shaft, resulting in a secure restraint of the main shaft without applying a bending force on the main shaft.

258. **Hanxing**: Hanxing discloses a main rotor shaft clamp used for replacing a gearbox of a wind turbine with a single supporting main shaft.



Hanxing, Figure 4 (annotated).

259. More specifically, Hanxing discloses a rotor clamp comprising “upper clamping hoop 61, lower clamping hoop 62, and anti-rotation plate 63. The upper and lower clamping hoops 61/62 encircle the main shaft 2 [blue in Hanxing Figure 4 above] and are securely fastened together to tightly hold the main shaft 2.” See Hanxing at [0029].

260. In order to adapt to the rotor shaft, Hanxing discloses “two arc-shaped steel plates 64 [pink in Hanxing Figure 4 above] can be installed inside each of the upper clamping hoop 61 and the lower clamping hoop 62, forming a steel sleeve with four steel plates 64” around the rotor shaft. *Id.* at [0031]. Hanxing further discloses that “a layer of soft wear-resistant material 65,” (red in Hanxing Figure 4

above), e.g., a brake pad, “can also be added inside the steel sleeve for better sealing.” *Id.*

261. Finally, Hanxing discloses that “[m]ore than two screw holes are provided on the upper and lower clamping hoops 61/62, and bolts 10 [circled in orange in Hanxing Figure 4 above] passing through these screw holes will tightly press the steel sleeve against the main shaft 2 to ensure surface contact.” *Id.* at [0031]. The adjustable bolts 10 engaging four steel plates are radial displaceable and substantially symmetrical, being located around the center axis of the main shaft. The bolts 10 are displaceable between a passive position where sleeve 64 is located at a distance from a surface of the main shaft and an active position where the sleeve 64 is configured to be engaged with the main shaft 2.

262. It would have been well known to a POSITA that application of a friction force from torque clamps or friction brakes as taught by Signore or Weaver would result in the application of a radial force to the main shaft. This radial force can create a bending moment on the main shaft. Such a radial force and bending moment can damage the main shaft or other components of the wind turbine unless balanced by an equal and opposing force. Selecting the number and locations of torque clamps or friction brakes would be a matter of design decision, and a POSITA would have recognized that well known devices like the device taught by Hanxing provide a set of equally spaced and equal but opposite forces on the main shaft,

resulting in a secure restraint of the main shaft without applying a bending force on the main shaft.

263. A POSITA would find it obvious to include “at least three radial displaceable pressure mandrels, substantially symmetrical[ly] located around a centre axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes” in the main shaft fixture of Signore and Weaver.

264. In light of the foregoing discussion, the claimed elements of Claim 2 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

7. **Claim 3: “Main shaft fixture, according to claim 1, characterized in, that the mounting facilities are adapted for anchoring a self-hoisting crane on/in a nacelle of a wind turbine and in that a winch of the self-hoisting crane is located on a ground surface near a foot of the wind turbine.”**

265. The main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway. *See supra* Section XII.A.5.

266. Claim 3 is taught by Signore and Weaver.

267. In the April 26, 2024 Office Action, the examiner found that “[w]ith claims 3 and 13-14, as modified by Weaver et al,” ***“the main shaft fixture [of the Signore Application] further comprises mounting facilities for a self-hoisting***

crane having winch located on a ground surface near a foot of the wind turbine,”

and that “*the structure of the main shaft fixture is capable for mounting with a self-hoisting crane, such as by using a chain or a cable connected between the crane and the main shaft fixture.*” Exhibit 1002, at 89 (April 26, 2024 Non-Final Rejection, at 7). I agree with this finding.

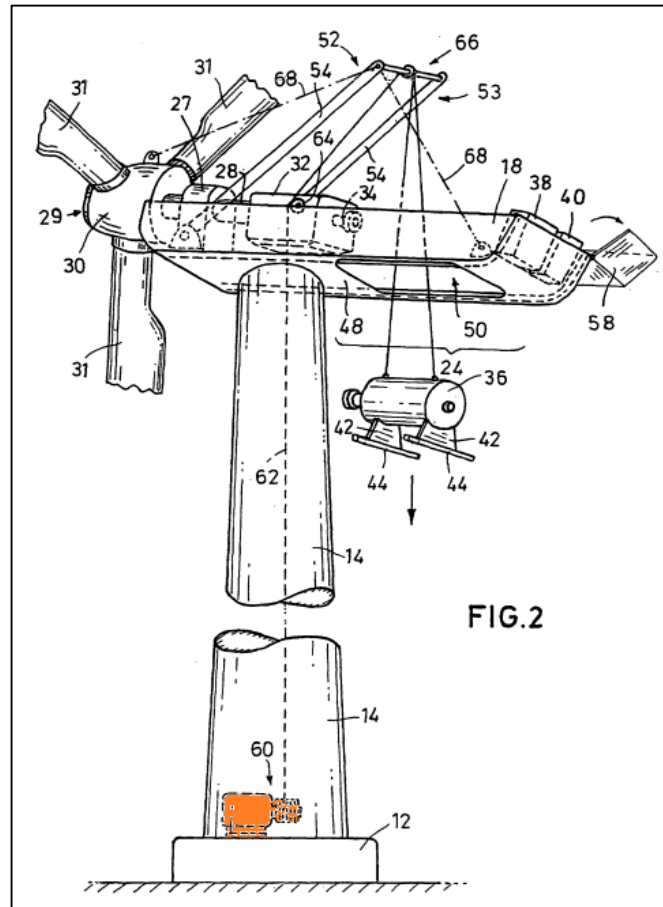
268. To the extent that this element is not taught by Signore as modified by Weaver, it would have been obvious to a POSITA to include “mounting facilities adapted for anchoring a self-hoisting crane on/in a nacelle of a wind turbine” on the main shaft fixture of Signore modified by Weaver, where “a winch of the self-hoisting crane is located on a ground surface near a foot of the wind turbine.”

269. Provision of “mounting facilities adapted for anchoring a self-hoisting crane on/in a nacelle of a wind turbine would have been obvious to a POSITA, as described above in relation to Claim 1. *See supra* Section XII.A.5.e. The further addition of a winch located on the ground surface would have been obvious to a POSITA as such crane and winch arrangements were well-known in the wind industry at the relevant time frame. For example, the ’578 Patent admits that “[t]he use of self-hoisting cranes, whose winches are placed on the ground surface near the turbine’s tower, is increasing, because the use of such involves large savings in the level of expenses for servicing of wind turbines since the use of large mobile cranes

for handling the above-mentioned large and heavy components is made superfluous.” ’578 Patent, 1:66-2:5.

270. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver alone. However, my opinion is bolstered by the fact that crane winches located on a ground surface near the foot of the wind turbine were well known in the art. Engineers in the wind energy industry have long understood that crane winches include a large spool of cable, rope, or chain, and that this spool would be unwieldy if located in the nacelle, and so they have frequently opted to locate the winch on the ground, with pulleys or snatch blocks in the nacelle to guide the cable or chain. The well-known nature of crane winches located on a ground surface near the foot of the wind turbine is further corroborated, for example, by Weitkamp:

271. **Weitkamp:** Weitkamp teaches a crane system for replacing the main components of the machine housing of a wind turbine where the “rope winch 60 [(orange in Weitkamp Figure 2 below)] can be mounted at the bottom of the foundation 12 of the tower 14, from which a rope 62 runs inside the tower or outside of the tower 14 past into the machine housing 18 and from there via a deflection roller 64 to the upper end 66 of the crane arms 54.” Weitkamp at [0022]; *see also id.* [0013] (“[I]t is advisable to arrange a cable rope [(60)] or similar load-pulling device drive on the foundation ... of the tower”).



272. Weitkamp further teaches using the winch to lift heavy components into the nacelle of the wind turbine. *Id.* at [0022] and Fig 2. (lifting a generator), Fig. 3 (gearbox), Fig. 4 (rotor blade), [0025] and Fig. 5 (hub), [0016] and Fig. 6 (main bearing and shaft),

273. It would have been obvious to a POSITA to use a well-known ground-based winch like the one taught by Weitkamp, located near a foot of the wind turbine, as a hoist of a self hoisting crane. Including a well-known ground-based winch like the one taught by Weitkamp would have been an obvious design choice at the relevant time period for a POSITA because it removes a heavy and bulky element

Declaration of John Bosche in Support of Petition for
Inter Partes Review of U.S. Pat. No. 12,104,578
of the self-hoisting crane from the nacelle where space is constrained and where
lifting and handling heavy elements like a winch can be difficult and problematic.

274. In light of the foregoing discussion, the claimed elements of Claim 3
would have been obvious to a POSITA as of the priority date of the '578 Patent as
taught by the combination of Signore and Weaver in of Power Climber, Holloway,
and/or Stegemann.

**8. Claim 4: “Main shaft fixture, according to claim 1,
characterized in, that the adjustable pressure mandrels is
provided with actuators for displacing and retaining the tap
shoes in the passive position and the active position,
respectively, alternatively in a selectable position between
the passive and the active position.”**

275. The main shaft fixture of Claim 1 is taught by Signore and Weaver in
view of Power Climber, Stegemann and/or Holloway. *See supra* Section XII.A.5.

276. The additional elements recited in Claim 4 are taught by Signore and
Weaver.

277. An actuator is a component of a machine that produces force, torque,
or displacement, when an electrical, pneumatic or hydraulic input is supplied to it.
Actuators have been a well-known element of hydraulic, pneumatic, and electro-
mechanical systems for many decades.

278. Weaver discloses “[h]ydraulic or mechanically operated friction brakes
518” that “are provided on opposing brake support flanges 519 extending in an

essentially axial direction from an end 516 of half-spool member 401” and act to
“clamp main shaft 402 and thereby inhibit rotation of shaft 402.” Weaver at [0017]

279. In addition, in an April 26, 2024 Office Action, the examiner found with regard to claim 4 that “as modified by Weaver et al, the pressure mandrels are provided with actuators (hydraulic or mechanical operated) for displacing and retaining the tap shoes in the passive position and the active position, respectively, alternatively in a selectable position between the passive and the active position.” Exhibit 1002, at 89 (April 26, 2024 Non-Final Rejection, at 7). I agree with this finding.

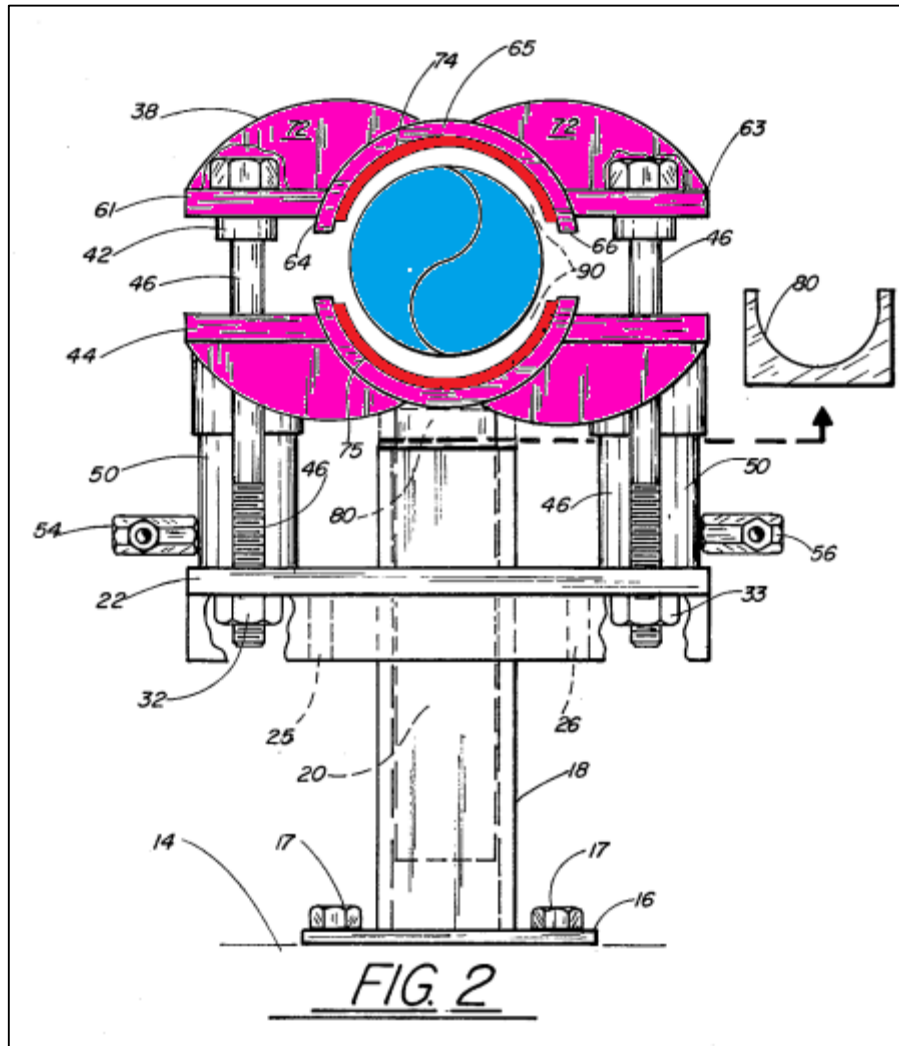
280. Further, in the prosecution of the ’578 Patent, Patent Owner did not dispute that the claimed “[m]ain shaft fixture ... characterized in, that the adjustable pressure mandrels is provided with actuators for displacing and retaining the tap shoes in the passive position and the active position, respectively, alternatively in a selectable position between the passive and the active position” was obvious in view of Signore as modified by Weaver. *See supra* Section VII.C.

281. The use of actuators would have been known by a POSITA to provide several expected advantages. For example, actuators can provide mechanical force that can increase the friction between the tap shoes and the main shaft. Actuators allow the main shaft fixture to be installed quickly on the main shaft. They also

allow remote operation of the tap shoes, potentially providing greater safety for operators.

282. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver alone. However, my opinion is bolstered by the fact that actuators for displacing and retaining the tap shoes in the passive position and the active position, respectively, alternatively in a selectable position between the passive and the active position were well known in the art. For example, this is corroborated by the Boudreaux and Fetzner references.

283. **Boudreaux:** Boudreaux discloses a shaft immobilizer used in the energy industry, in particular “[i]n the use of large boats, particularly in crew boats, in servicing the offshore oil and gas industry.” Boudreaux at 1:5-14.



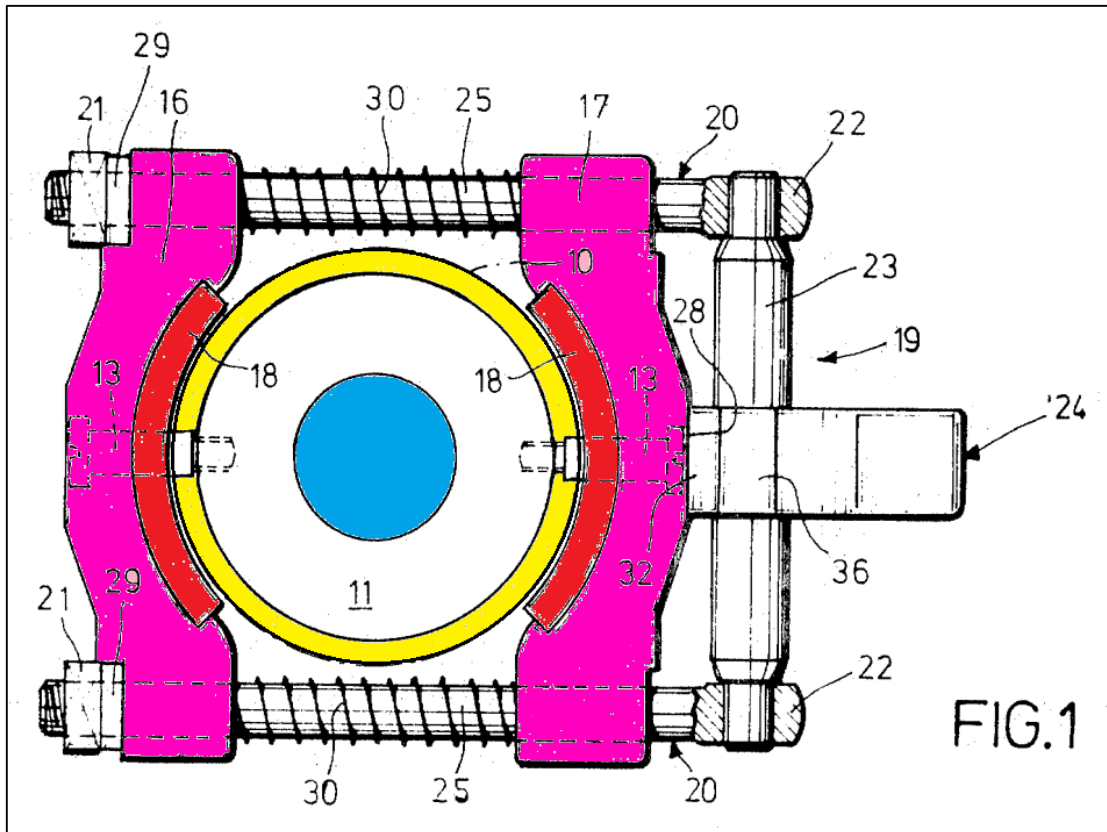
284. Boudreaux discloses hydraulic valves that can be used to maintain the upper and lower engaging sections either in contact with the shaft, or in a position away from the shaft. When the valve handles are in a closed position, “the hydraulic fluid between valve 69 and hydraulic cylinders 50 [is maintained] in the constant pressurized state, and therefore ***maintain apparatus 10 in the closed position around propeller shaft 11.*** Likewise ***in order to free propeller shaft 11, valve 62A is open,*** and the hydraulic pressure is therefore relieved, and lower section 44 drops

back into place against the upper portion of mounting post 18, and upper section 38 is moved upward due to the expansion of springs within hydraulic cylinders 50, thus ***providing 1/2 inch clearance space 90 for clear rotation of shaft 11 during use.***
Id. at 7:14-29.

285. In the event that hydraulic pressure is not available, Boudreaux discloses manual activation of the propeller shaft immobilizer apparatus by the use of threaded bolts: “In order to manually set the apparatus in frictional engagement with shaft 11, the head of bolts 28 through 31 are rotated by a wrench or the like, which would cause bolts 28 through 31, since they are threaded through the floor 22 of apparatus 10, would lower the upper engaging section 38 and frictional engagement with shaft 11, and likewise raise lower engaging section 44 in frictional engagement, as seen in FIG. 4.” *Id.* at 7:58-8:10.

286. **Fetzer:** When the pivotable brake lever of Fetzer is operated, “***nuts 21 serve to displace the first brake shoe 16*** [(pink in Fetzer Figure 1 below)] ***towards the friction face 10*** [(yellow in Fetzer Figure 1 below)] and further serve for setting the magnitude of the braking force in the stable position 34 of the lever 24. Between each nut 21 and an adjacent portion of the first brake shoe 16 there is provided an elastic disc 29. Between the two brake shoes 16 and 17 [(pink in Fetzer Figure 1 below)] ***each bar 20 is surrounded by a biased compression spring 30 which***

continuously urges the two brake shoes 16, 17 into positions in which they are disengaged from the brake face 10 of the spindle.” Id. at 2:45-59.



Fetzer, Figure 1 (annotated).

287. In light of the foregoing discussion, the claimed elements of Claim 4 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

9. **Claim 6: “Main shaft fixture, according to claim 1, characterized by a slideway lining being located between opposing sides of a surface of the main shaft and tap shoes.”**

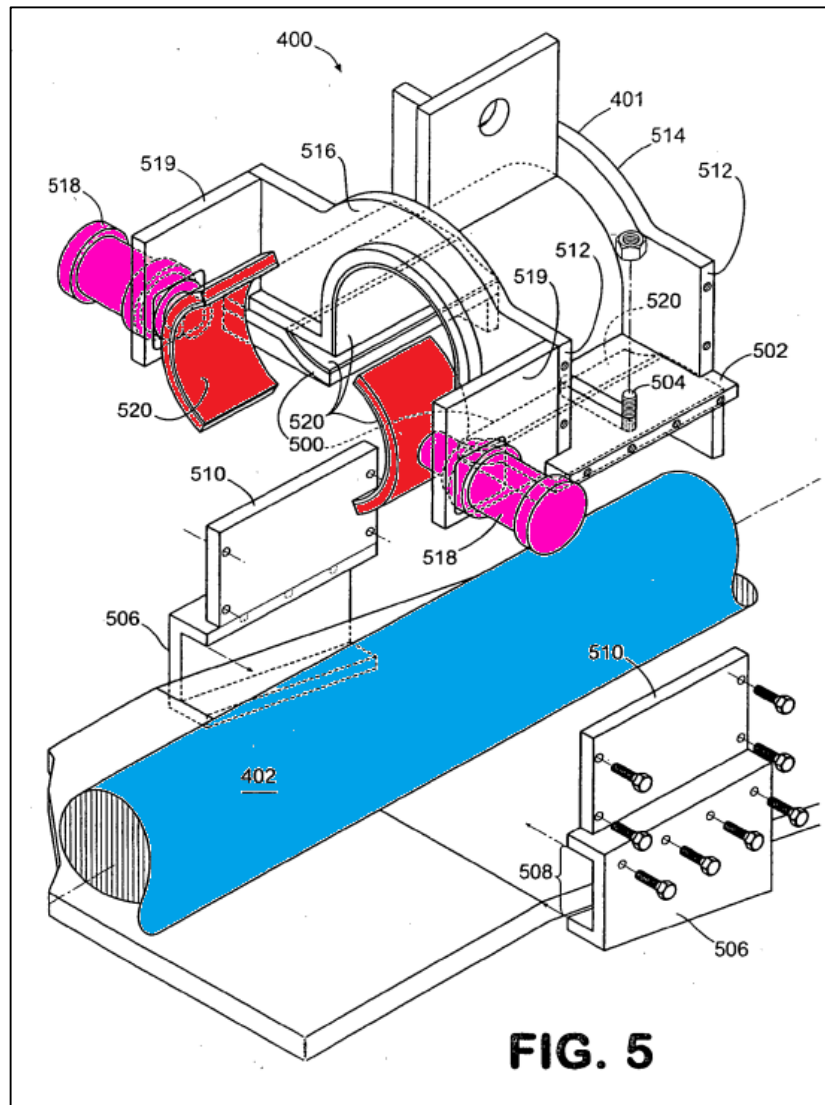
288. The main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann. *See supra* Section XII.A.5.

289. Signore and Weaver teach this element.

290. The '578 Patent describes that the claimed slideway lining “involves ***the main shaft 4 being permitted to rotate*** simultaneously with it being fixed in its position during servicing of the wind turbine, which can serve a purpose namely for larger wind turbines.” '578 Patent at 6:46-51. Further, the '578 Patent concedes in the background section that allowing a small amount of rotation was well known in the art. *See* '578 Patent at 2:14-22 (describing as background that it “[***may***] ***be appropriate to simply retain the shaft in position and permit a certain rotation of the shaft,***” explaining that doing so “is possible by turning the blades/nacelle out of the wind so that the shaft via the effects of the wind on the blades only rotates very slowly, or not at all, whereby it is acceptable in terms of safety, to perform service work in the nacelle of the wind turbine concerned”). This method of turning the blades/nacelle out of the wind has been known and practiced within the wind energy industry since the 1980s, and is referred to as “yawing out” of the wind. It has long been a common practice during maintenance and inspection activities. Other methods of stopping or slowing the rotor were also in common use at the time of effective filing date of the '578 Patent, including application of a mechanical friction

brake (on either the high speed or low speed shaft), or pitching the blades 90 degrees so that they do not produce aerodynamic lift.

291. Weaver discloses a slideway lining (520) being located between opposing sides of a surface of the main shaft and tap shoes.



292. More specifically, Weaver discloses that “[i]n some configurations, *shaft-restraining members 400 are configured to allow for rotation of rotor 104 during high wind speed events that may occur during replacement of gearbox 300 to*

prevent damage to wind turbine 100 or the danger of heavy components that might shear off in such conditions. For example, ***surfaces 520 are Teflon(TM)-covered or provided with roller bearing surfaces in some configurations that allow rotation of shaft 402 above a predetermined torque.*** Weaver at [0018]; *see also* Weaver Claim 6 (claiming “surfaces (520) configured to allow rotation of the shaft above a predetermined torque, during high speed wind events which occur during replacement of the gearbox.”).

293. In addition, in the April 26, 2024 Office Action, the examiner found that “[w]ith claim 6, Weaver et al teaches a slideway lining (520) (Teflon) is located between the opposing sides of the surface of the main shaft and tap shoes (the inner end the brake) (see Figure 5, paragraph [0018]).” Exhibit 1002, at 89 (April 26, 2024 Non-Final Rejection, at 7). The examiner concluded that “[t]herefore, it would have been obvious to one with ordinary skill in the art before the effective filing date of the claimed invention to modify the tap shoes (244) of Signore et al to have a Teflon lining as taught by Weaver et al in order to allow rotation of the main shaft above a predetermined torque.” *Id.* I agree with these findings.

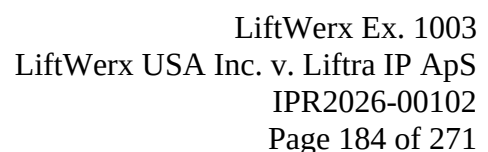
294. Further, in the prosecution of the ’578 Patent, Patent Owner did not dispute that the claimed “[m]ain shaft fixture ... characterized by a slideway lining being located between opposing sides of a surface of the main shaft and tap shoes” was obvious in view of Signore as modified by Weaver. *See supra* Section VII.C.

295. In light of the foregoing discussion, the claimed elements of Claim 6 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

10. Claim 7: “Main shaft fixture according to claim 6, characterized in, that the slideway lining is configured so that of [sic] opposing free ends of the tap shoes facing the main shaft are provided with a slide plate which in the active position is engaged with the main shaft.”

296. The main shaft fixture of Claim 6 is taught by Signore and Weaver. *See supra* Sections XII.A.5 & XII.A.9. Weaver discloses this element.

297. Weaver discloses a slideway lining (520) configured so that opposing free ends of the tap shoes facing the main shaft are provided with a slide plate which in the active position is engaged with the main shaft.



298. More specifically, Weaver discloses that “[i]n some configurations, shaft-restraining members 400 are configured to allow for rotation of rotor 104 during high wind speed events that may occur during replacement of gearbox 300 to prevent damage to wind turbine 100 or the danger of heavy components that might shear off in such conditions. For example, ***surfaces 520 are Teflon(TM)-covered or provided with roller bearing surfaces in some configurations that allow rotation of shaft 402 above a predetermined torque.***” Weaver at [0018]; see also Weaver

Claim 6 (claiming “***surfaces (520) configured to allow rotation of the shaft above a predetermined torque***, during high speed wind events which occur during replacement of the gearbox.”).

299. In addition, in the April 26, 2024 Office Action, the examiner found that “[w]ith claim 7, the slideway lining (520) is configured so that the opposing free ends of the tap shoes facing the main shaft are provided with a slide plate (520) (Teflon) which in the active advanced position is engaged with the main shaft.” Exhibit 1002, at 89 (April 26, 2024 Non-Final Rejection, at 7). Further, the examiner concluded that “it would have been obvious to one with ordinary skill in the art before the effective filing date of the claimed invention to modify the tap shoes (244) of Signore et al to have a Teflon lining as taught by Weaver et al in order to allow rotation of the main shaft above a predetermined torque.” *Id.* I agree with this finding.

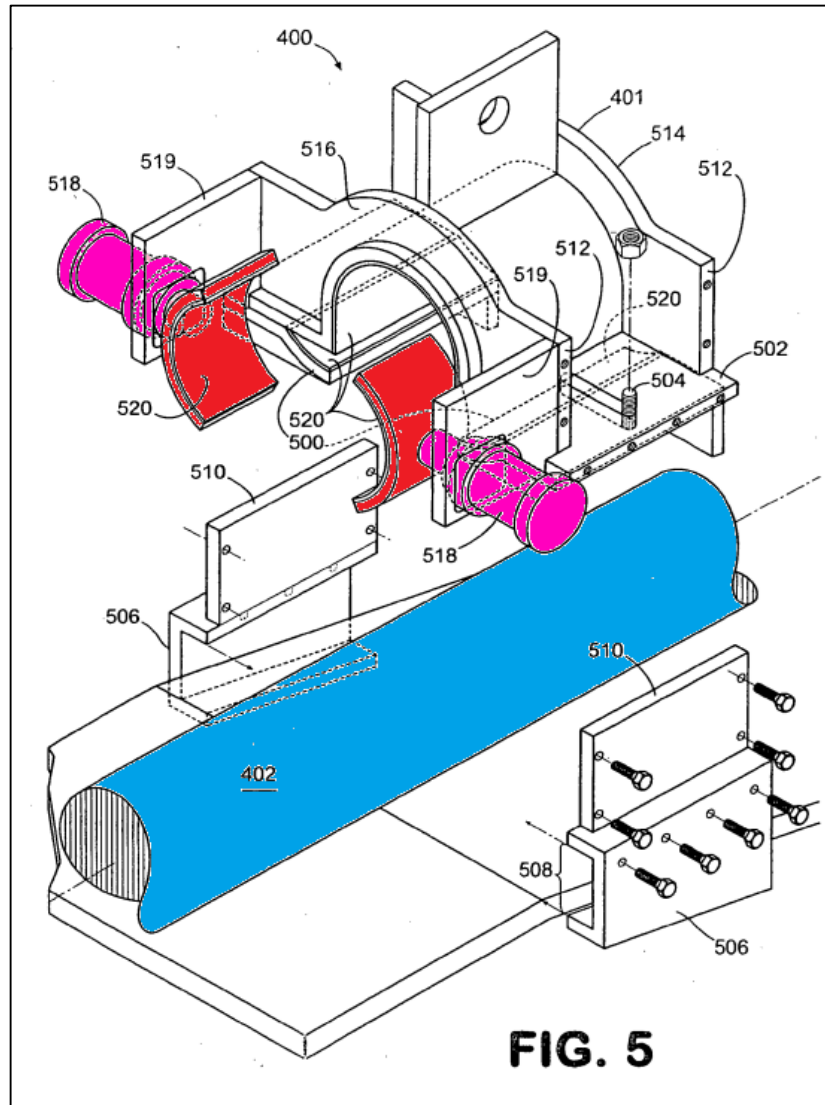
300. In addition, in the prosecution of the '578 Patent, Patent Owner did not dispute that the claimed “[m]ain shaft fixture ... characterized in, that the slideway lining is configured so that of opposing free ends of the tap shoes facing the main shaft are provided with a slide plate which in the active position is engaged with the main shaft” was obvious in view of Signore as modified by Weaver. *See supra* Section VII.C.

301. In light of the foregoing discussion, the claimed elements of Claim 7 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in View of Power Climber, Holloway, and/or Stegemann.

11. **Claim 8: “Main shaft fixture according to claim 7, characterized in that it comprises a multi-part slide plate cooperating with the main shaft for mounting on the main shaft, where the multi-part slide plate in its mounted position on the main shaft is cooperating with the tap shoes.”**

302. The main shaft fixture of Claim 7 is taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway. *See supra* Sections XII.A.5, XII.A.9, & XII.A.10. Weaver discloses this element.

303. Weaver discloses a multi-part slide plate cooperating with the main shaft for mounting on the main shaft, where the multi-part slide plate in its mounted position on the main shaft is cooperating with the tap shoes.



304. More specifically, Weaver discloses that “***surfaces 520*** are Teflon(TM)-covered or provided with roller bearing surfaces in some configurations that allow rotation of shaft 402 above a predetermined torque.” Weaver at [0018]; *see also* Weaver Claim 6 (claiming “***surfaces (520)*** configured to allow rotation of the shaft above a predetermined torque.”).

305. In addition, in the April 26, 2024 Office Action, the examiner found that “[w]ith claim 8, the slideway linings (520) are a multi-part slide plate

cooperating with the main shaft for mounting on the main shaft, where the multi-part slide plate in a mounted (clamped or engaged) position on the main shaft cooperates with the tap shoes.” Exhibit 1002, at 90 (April 26, 2024 Non-Final Rejection, at 8). Further, the examiner concluded that “it would have been obvious to one with ordinary skill in the art before the effective filing date of the claimed invention to modify the tap shoes (244) of Signore et al to have a Teflon lining as taught by Weaver et al in order to allow rotation of the main shaft above a predetermined torque.” *Id.* at 89 (April 26, 2024 Non-Final Rejection, at 7). I agree. The choice of a surface on the tap shoes, including Teflon or other types of surfaces, would have been an obvious design decision to a POSITA because it allows the coefficient of friction to be controlled. Controlling the coefficient of friction is important to provide torque forces to the main shaft for the purpose of resisting wind flow over the rotor, but also limiting the torque forces in order to prevent damage in case of a high wind gust.

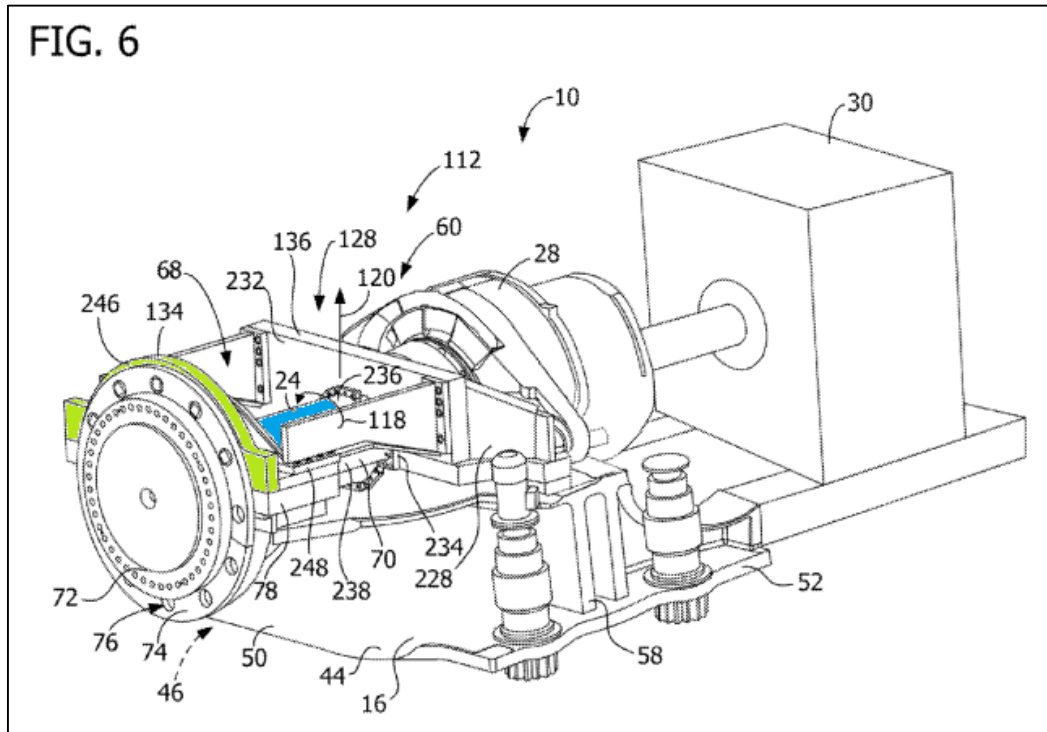
306. In addition, in the prosecution of the '578 Patent, Patent Owner did not dispute that the claimed “multi-part slide plate cooperating with the main shaft for mounting on the main shaft, where the multi-part slide plate in its mounted position on the main shaft is cooperating with the tap shoes” was obvious in view of Signore as modified by Weaver. *See supra* Section VII.C.

307. In light of the foregoing discussion, the claimed elements of Claim 8 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

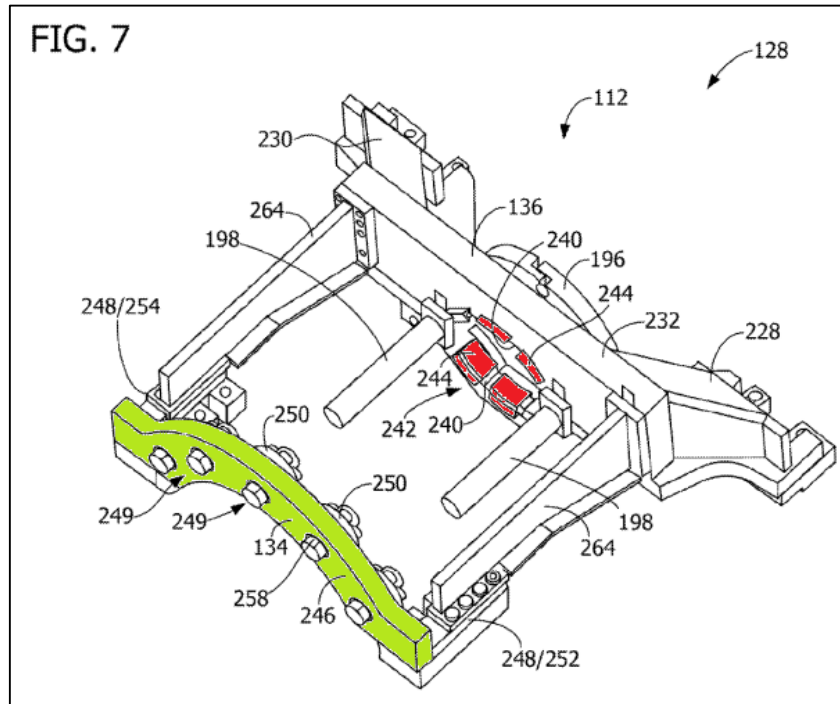
12. Claim 10: “Main shaft fixture, according to claim 1, characterised in, that it comprises a rotor lock for fixation of a rotor of the wind turbine.”

308. The main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Stegemann and/or Holloway. *See supra* Section XII.A.5. Signore and Weaver teach this element.

309. Signore discloses a rotor lock (green in Signore Figure 6 below) that uses bolts placed through the rotor lock and the rotor flange via mating holes in order to lock rotation of a wind turbine rotor shaft (blue in Signore Figure 6 below).

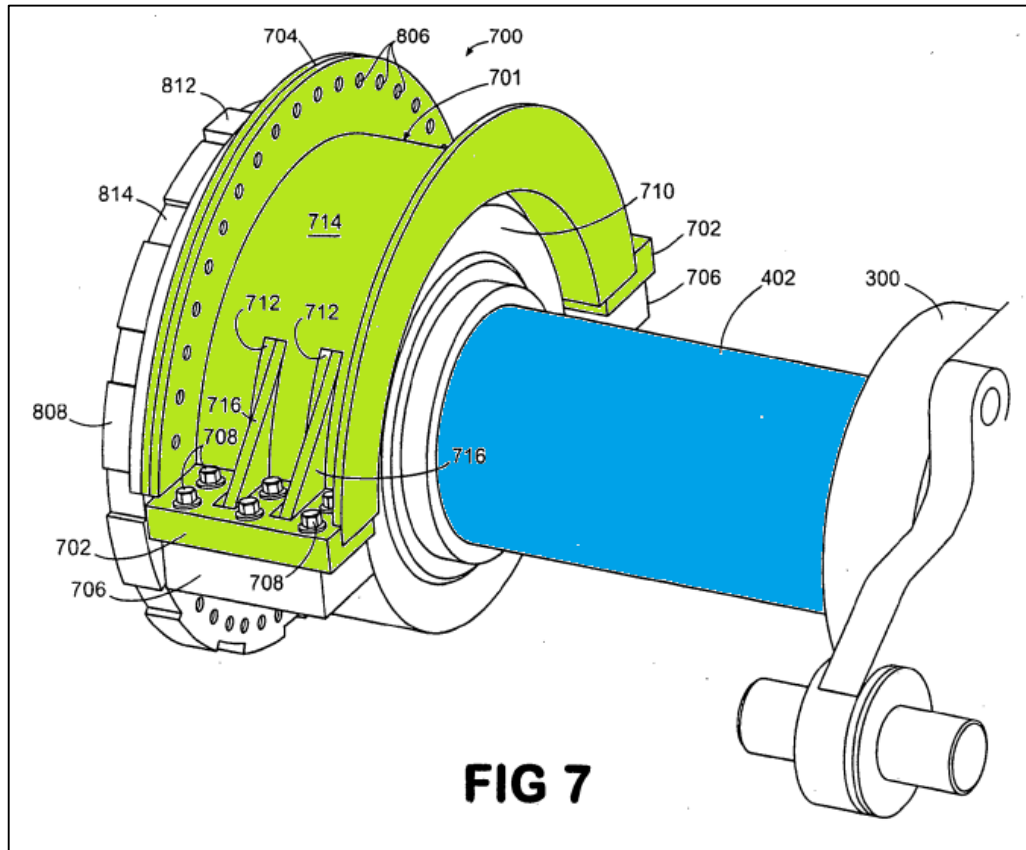


310. More specifically, Signore discloses a “shaft support assembly 128,” pictured in Signore Figure 7 below, that “includes a drive shaft locking assembly 134 [(green in the figure below)] and a restraint assembly 136. Shaft locking assembly 134 is adapted to be coupled to support frame 16 and to rotor locking member 74 to facilitate limiting a rotation of drive shaft 24 about drive shaft axis 66.” Signore at [0031]; *see also id.* at [0022] (describing the rotor locking member 74 on drive shaft 24 that mates with the drive shaft locking assembly 134).



311. In addition, the “[s]haft locking assembly 134 [(green in Signore Figure 6 above)] is adapted to be coupled to support frame 16 and to rotor locking member 74 to facilitate limiting a rotation of drive shaft 24 about drive shaft axis 66,” and “restraint assembly 136 is adapted to be coupled to support frame 16 and to drive shaft 24 to facilitate limiting an upward movement of drive shaft 24.” *Id.* at [0031].

312. In addition, Weaver also discloses a rotor lock that employs bolts placed through the rotor lock and the rotor flange via mating holes in order to lock rotation of the rotor shaft. *Id.* at [0011].



313. More specifically, Weaver discloses that “[b]y fastening semi-annular member 704 to mounting flange 806, half-spool member 701 to semi-annular member 704, and half-spool member 701 to mounting flanges 706 or to bolts 708 therein [(704 and 701 green in Weaver Figure 7 above)], shaft 402 [(blue in Weaver Figure 7 above)] is effectively restrained from tilting and its rotation effectively inhibited. Gearbox 300 can then be safely removed and replaced.” *Id.* at [0023].

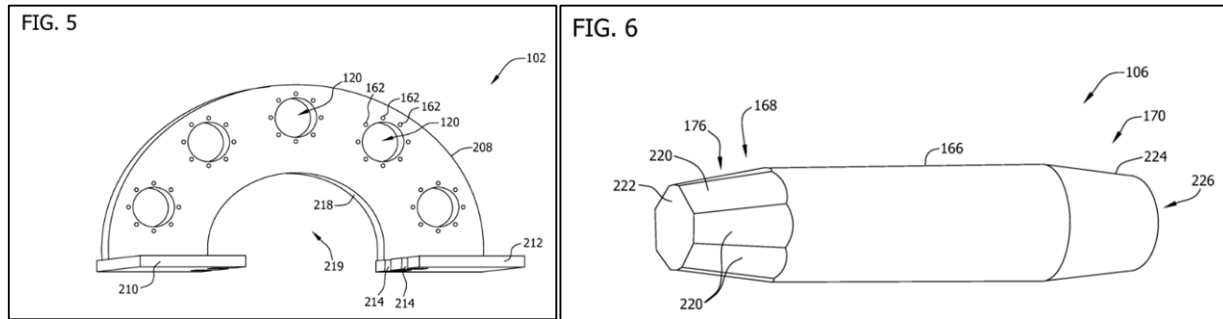
314. Weaver also discloses additional embodiments of rotor locks. *See, e.g., id.* at [0020] (disclosing a rotor lock with a “differently configured half-spool member 701 having mounting ears or flanges 702 and a semi-annular member 704”), [0022] (disclosing a rotor lock in which “half-spool member 701 is placed over main

shaft 402, and more particularly over journal or bearing 710”), [0024] (disclosing a rotor lock with “one or more axially extending protuberances 812 such as a tooth, a key, or a wedge” on “semi-annular member 704” to “engage[] an appropriately shaped gap 814 in a circumference of mounting flange 808 to effectively inhibit rotation of shaft 402”).

315. In addition, in an April 26, 2024 Office Action, the examiner found that “[w]ith claim 10, the main shaft fixture [of Signore] further compris[es] a rotor lock (134) for fixation of the rotor of the wind turbine (see Figures 5-8 and paragraphs [0022] and [0054]).” Exhibit 1002, at 90 (April 26, 2024 Non-Final Rejection, at 8). I agree.

316. In addition, in the prosecution of the ’578 Patent, Patent Owner did not dispute that the claimed “[m]ain shaft fixture ... characterized in, that the adjustable pressure mandrels is provided with actuators for displacing and retaining the tap shoes in the passive position and the active position, respectively, alternatively in a selectable position between the passive and the active position” was obvious in view of Signore as modified by Weaver. *See supra* Section VII.C.

317. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver alone. However, my opinion is bolstered by the fact that rotor locks for fixation of a rotor of the wind turbine were well known in the art. For example, this is corroborated by Koronkiewicz:



320. As depicted in Koronkiewicz Figure 5 and 6, above, “[r]otor lock assembly 30 includes a support frame 102 coupled to bedplate frame 78, a plurality of lock pin housings 104 coupled to support frame 102, and a plurality of lock pins 106 coupled to each lock pin housing 104 and adapted to contact rotor lock disk 52. Each lock pin 106 is configured to be inserted through a corresponding rotor lock disk opening 54 to facilitate coupling rotor lock assembly 30 to rotor lock disk 52.” Koronkiewicz at 4:57-5:4.

321. In light of the foregoing discussion, the claimed elements of Claim 10 would have been obvious to a POSITA as of the priority date of the ’578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

- 13. Claim 13: “Assembly for installing and repairing heavy parts of a wind turbine arranged in a nacelle of a wind turbine, the assembly comprising a main shaft fixture according to claim 1, characterized in that a crane is mounted to the main shaft fixture via the mounting facilities of the main shaft fixture.”**

322. The assembly for installing and repairing heavy parts of a wind turbine and main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Stegemann and/or Holloway. *See supra* Section XII.A.5.

323. It would have been obvious to mount a crane to the main shaft fixture via the mounting facilities of the main shaft fixture. This element is taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway. *See supra* Sections XII.A.5.e & XII.A.7.

324. The requirements of claim 13 add relatively little to the claimed elements of claim 1. The only difference is that in claim 13 a “crane is mounted to the main shaft fixture” rather than merely providing “mounting facilities *adapted for* anchoring a crane.”

325. Based on the teachings discussed above in relation to Claim 1, a POSITA would recognize that the combination of elements recited in Claim 13 are obvious as taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway. Power Climber, Stegemann, and/or Holloway each teach a crane in its mounted state.

326. In addition, in the April 26, 2024 Office Action, the examiner found that “[w]ith claims 3 and 13-14, as modified by Weaver et al,” “***the main shaft fixture [of Signore] further comprises mounting facilities for a self-hoisting crane having winch located on a ground surface near a foot of the wind turbine,***” and

that “***the structure of the main shaft fixture is capable for mounting with a self-hoisting crane, such as by using a chain or a cable connected between the crane and the main shaft fixture.***” Exhibit 1002, at 89 (April 26, 2024 Non-Final Rejection, at 7). I agree with this finding.

327. In light of the foregoing discussion, the claimed elements of Claim 13 would have been obvious to a POSITA as of the priority date of the ’578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

14. Claim 14: “Main shaft fixture, according to claim 1, characterised in that the mounting facilities are adapted for anchoring a lightweight crane on/in a nacelle of a wind turbine.”

328. The main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Stegemann and/or Holloway. *See supra* Section XII.A.5.

329. It would have been obvious to include mounting facilities on the main shaft fixture adapted for anchoring a crane on/in a nacelle of a wind turbine. This element is taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway. *See supra* Sections XII.A.5.e, XII.A.7, & XII.A.13.

330. Stegemann teaches that a lightweight crane with “individual components of [that] ... preferably do not exceed about 30 kg and are sufficiently lightweight and sufficiently small to be handled manually” may be “attached to the

wind turbine by attachment plate 311,” which “may attach to ... existing components, and utilize existing fastening locations.” Stegemann at [0046], [0039].

331. In addition, this is taught by Holloway. *See supra* Section XII.A.5.e (discussing lightweight cranes of Holloway and Stegemann). Further, Holloway teaches that the crane may be a “portable cranes which are lightweight, inexpensive, and have high load capacities[, which] would be advantageous.” Holloway, 1:41-43.

332. The device recited in Claim 14 is identical to that recited in Claim 1 except that the “mounting facilities” are adapted for anchoring a “lightweight” crane, where the addition of the word “lightweight” is the only modification. It is noted that the term “lightweight” is a relative term and does not have a sufficiently precise meaning in the context of the ’578 Patent. A “heavy” crane in one context can be considered a “lightweight” crane in another context. It is not clear how the modifying word “lightweight” should be interpreted in Claim 14, or at what point a crane becomes too heavy to still be considered “lightweight.” For the purposes of this Declaration, although it is my opinion that a POSITA would understand many of the cranes discussed herein to be lightweight, a POSITA would not be able to sufficiently identify the metes and bounds of the term “lightweight” for purposes of assessing the scope of Claim 14.

333. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver in view of Power Climber, Stegemann and/or Holloway alone. However, my opinion is bolstered by the fact that cranes a POSITA would consider lightweight and that were mounted to a main shaft fixture were well known in the art. For example, this is corroborated by the Power Climber Brochure, which teaches the use of a lightweight crane that weighs just 37 lbs. and has a “[h]eaviest [s]ingle [p]iece that weighs just 19 lbs.” Power Climber Brochure (Ex. 1027) at 1, 2.

334. A POSITA would find it obvious to attach the lightweight crane of Power Climber, Stegemann, or Holloway to the main shaft fixture of Signore in view of Weaver for the same reasons as provided above in relation to Claim 1.

335. In light of the foregoing discussion, the claimed elements of Claim 14 would have been obvious to a POSITA as of the priority date of the ’578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann.

B. Ground 2: Claims 2, 5, and 15 are Rendered Obvious by the Combination of Signore and Weaver in View of Power Climber, Stegemann and/or Holloway and Further in View of Hanxing or Schulz

336. As discussed above, a POSITA would have been motivated to combine Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann. A POSITA would have been further motivated to add to this combination the teachings

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of Hanxing and/or Schulz—particularly with respect to number of pressure mandrels
and use of threaded bolts.

**1. A POSITA Would have Been Motivated to Combine
Signore and Weaver with Hanxing with a Reasonable
Expectation of Success**

337. Like Signore and Weaver (*see* discussion of Signore and Weaver above (*supra* Section XII.A.1)), Hanxing is concerned with the cost of repairing/replacing components in a wind turbine, especially the gearbox. *See* Hanxing at [0003] (“Currently, the disassembly method requires first removing the blades and then hoisting the main shaft and gearbox together. This disassembly method requires a crane, incurs high costs, and takes a long time due to the large number of components involved, usually needing about two days, which prevents the generator set from quickly resuming operation and affects the power supply, especially during peak electricity usage. Therefore, how to quickly and safely disassemble the gearbox is an urgent technical problem that needs to be solved in this field.”). Like Signore and Weaver (*see* discussion of Signore and Weaver above, *supra* XII.A.3), an object of Hanxing is to eliminate the need for a large crane for removing the rotor of the wind turbine during gearbox repair or replacement. *See* Hanxing at [0016] (“The gearbox can be replaced directly on the wind turbine frame without using a crane, significantly shortening the replacement time to about one day.”).

338. Hanxing discloses upper and lower hoops that are fastened to each other around the main shaft of the wind turbine to “tightly hold the main shaft.” *Id.* at [0029]. The upper and lower hoops are attached to an anti-rotation plate 63 such that when the upper and lower hoops are secured to the wind turbine shaft, the shaft is held in place and rotation of the shaft is resisted. Hanxing further discloses that “a layer of soft wear-resistant material 65” can be added to the upper and lower hoops to act as a brake pad. *Id.* at [0031]. Moreover, Hanxing discloses screw holes in the upper and lower hoops and “bolts 10 passing through these screw holes will tightly press the steel sleeve against the main shaft 2 to ensure surface contact.” *See id.* at [0031].

339. Hanxing further discloses “[m]ore than two screw holes are provided on the upper and lower clamping hoops 61/62, and bolts 10 passing through these screw holes will tightly press the steel sleeve against the main shaft 2 to ensure surface contact.” *Id.* at [0031]. The adjustable bolts 10 engaging four steel plates are radially displaceable and substantially symmetrical, being located around the center axis of the main shaft. The bolts 10 are displaceable between a passive position where sleeve 64 is located at a distance from a surface of the main shaft and an active position where the sleeve 64 is configured to be engaged with the main shaft 2.

340. A POSITA would have been motivated to combine the bolts, as taught by Hanxing, with the shaft restraining devices taught by Signore and Weaver because the bolts provide a tight contact with the wind turbine shaft and ensure surface contact, including on wind turbines with unknown or varying shaft diameter. This provides greater security and safety during uptower maintenance activities, and allows a single device to be used on a wider range of wind turbine nacelle and shaft configurations, making the maintenance device more widely applicable.

341. A POSITA would be further motivated to combine Hanxing's teaching of using adjustable pressure points with Signore and Weaver because the adjustable pressure points taught by Hanxing provide additional flexibility to adapt to disparate shaft sizes, geometries, and heights. Further, a POSITA would have a reasonable expectation of success because four pressure points provide a more solid grasp on the main shaft than two or three pressure points can provide because the four pressure points provide orthogonal forces to resist movement in all directions (for example vertical and horizontal – or 45 degrees, 135 degrees, 225 degrees, and 315 degrees, as taught by Hanxing). Also, by adjusting the extension and retraction of each pressure point, it is possible to adjust for minor variations in shaft size, geometry, height, or location. Hanxing employs conventional mechanical elements in the way a POSITA would expect. The use of Hanxing's adjustable pressure points, together with the main shaft fixtures taught by Signore and Weaver, provides

expected benefits that would have been obvious to a POSITA, and does not provide any surprising or unexpected results when combined with a main shaft fixture.

**2. A POSITA Would Have Been Motivated to Combine
Signore and Weaver with Schulz with a Reasonable
Expectation of Success**

342. Like Signore and Weaver (*see* discussion of Signore and Weaver above (*supra* Section XII.A.1)), Schulz is concerned with repairing main shafts of power generation equipment. The shaft fixture of Schulz is used to make repairs, *id.* at 1:8-17, and would also be considered suitable for fixation of a main shaft on a wind turbine because a wind turbine is a piece of power generating equipment with a rotating shaft. As Schulz teaches, “[d]uring certain operations, it is necessary to hold the rotor shaft against rotation [and] [t]he brakes 50 and 52 are used to prevent the rotor shaft from rotating.” *Id.* at 5:67-6:1. Like Signore and Weaver, the brakes restrain the shaft using friction and, like Weaver, the brakes are operably extended to contact the shaft. *Id.* at 6:9-12 (“Wheel 136 of each brake is turned to extend brake pad 134 of each brake into engagement with the rotor shaft and thereby frictionally hold the rotor shaft against rotation.”). Therefore, since the rotating equipment on wind turbines occasionally require repair, similar to rotating equipment on other types of power generating equipment like discussed in Schulz, a POSITA would reasonably have looked toward Schulz for solutions to the problem of fixing a wind turbine shaft during repairs.

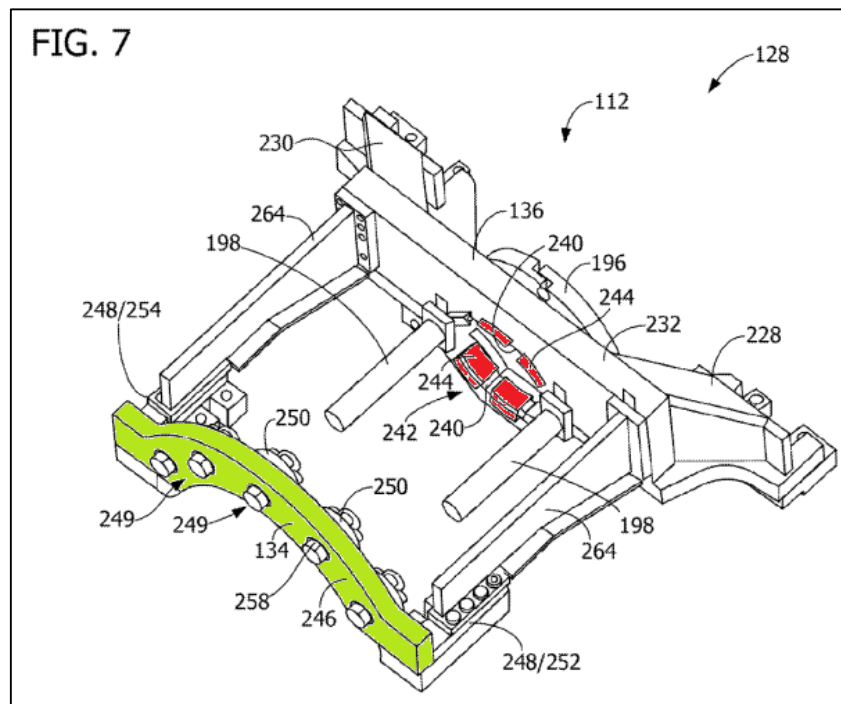
343. Because Schulz relates to the similar subject matter (namely repair of rotating equipment in the context of power generation) and solves similar problems as Signore and Weaver, a POSITA would be motivated to utilize the teachings of Schulz to improve the devices taught by Signore and Weaver. Further, a POSITA would have a reasonable expectation of success because Schulz teaches a shaft fixation device that is compatible with a wind energy application and capable of holding a shaft that weighs up to 150 tons for in-situ repairs. Schulz, 1:11-26. This shaft-handling capacity would be sufficient for performing repairs on a wind turbine shaft, thereby providing a POSITA with a reasonable expectation of success. Schulz employs conventional mechanical elements in the way a POSITA would expect. The use of Schulz's shaft fixture and brakes, together with the main shaft fixtures taught by Signore and Weaver, provides expected benefits that would have been obvious to a POSITA, and does not provide any surprising or unexpected results when combined with a main shaft fixture.

3. **Claim 2: "Main shaft fixture according to claim 1, characterized in that the adjustable pressure mandrels with tap shoes comprise at least three radial displaceable pressure mandrels, substantially symmetrical[ly] located around a centre axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes"**

344. The main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann. *See supra* Section XII.A.5.

345. Signore and Weaver further in view of Hanxing teach at least three radially displaceable pressure mandrels, substantially symmetrically located around a centre axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes. *See supra* Section XII.A.5.c.

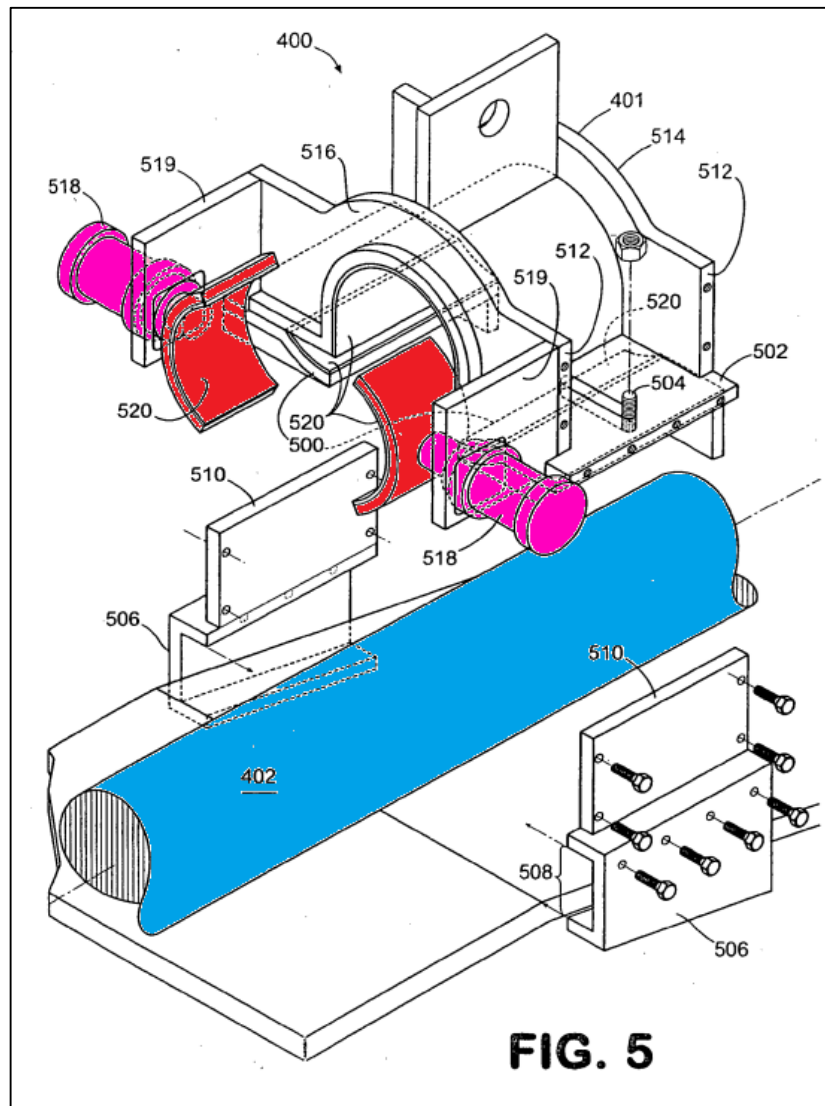
346. Signore discloses “a plurality of torque clamps 244” (red in Signore Figure 7 below), that are arranged radially around the center axis of the main shaft, “and are oriented circumferentially about opening 242. Each torque clamp 244 is configured to facilitate coupling restraint assembly 136 to drive shaft 24 via a friction fit to facilitate limiting a movement of drive shaft 24.” Signore at [0053]. As seen below, Figure 7 of Signore shows four torque clamps:



Signore Application, Figure 7 (annotated)

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347. In addition, Weaver discloses radially displaceable “[h]ydraulic or mechanically operated friction brakes 518” that “are provided on opposing brake support flanges 519 extending in an essentially axial direction from an end 516 of half-spool member 401” and act to “clamp main shaft 402 and thereby inhibit rotation of shaft 402.” Weaver at [0017]



Weaver, Figure 5

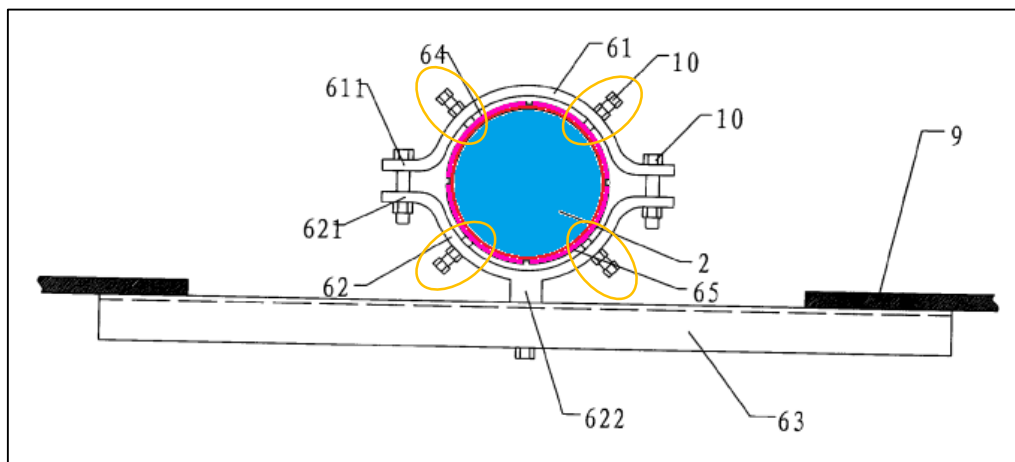
348. Further, in view of Signore's four torque clamps, a POSITA would find it obvious to use at least three radially displaceable friction brakes to Signore in view of Weaver because the radially displaceable friction brakes taught by Weaver as modified to include at least three radially displaceable friction brakes would have been recognized by a POSITA at the relevant time period as providing a more secure and more adjustable attachment point for securing the main shaft.

349. This is particularly true to better adapt to shafts of varying geometries. The use of three or more friction brakes also makes the device more easily adapted to variations in the height of the main shaft. It also allows the normal force (and hence friction force from the friction brakes) to be more equally distributed around the circumference of the main shaft. Moreover, selecting the number and locations of torque clamps or friction brakes would be a matter of design decision for a POSITA.

350. In addition, in an April 26, 2024 Office Action, the examiner found that "As to claim[] ... 2," "[t]he shaft restraining member [of Weaver] includes hydraulic or mechanic[ally] operated friction brakes (518). The clamping action of brakes (518) resists torque from rotor shaft (402). The hydraulic or mechanic brake comprises cylinders supported on brake support flange (519) of the shaft restraining member." Exhibit 1002, at 88 (April 26, 2024 Non-Final Rejection, at 6). I agree with these findings.

351. In addition, at least three radially displaceable pressure mandrels, substantially symmetrical located around a center axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes is disclosed by Hanxing:

352. **Hanxing**: Hanxing discloses a main rotor shaft clamp used for replacing a gearbox of a wind turbine with a single supporting main shaft.



Hanxing, Figure 4 (annotated).

353. More specifically, Hanxing discloses a rotor clamp comprising “upper clamping hoop 61, lower clamping hoop 62, and anti-rotation plate 63. The upper and lower clamping hoops 61/62 encircle the main shaft 2 [blue in Hanxing Figure 4 above] and are securely fastened together to tightly hold the main shaft 2.” See Hanxing at [0029].

354. In order to adapt to the rotor shaft, Hanxing discloses “two arc-shaped steel plates 64 [pink in Hanxing Figure 4 above] can be installed inside each of the

upper clamping hoop 61 and the lower clamping hoop 62, forming a steel sleeve with four steel plates 64” around the rotor shaft. *Id.* at [0031]. Hanxing further discloses that “a layer of soft wear-resistant material 65,” (red in Hanxing Figure 4 above), e.g., a brake pad, “can also be added inside the steel sleeve for better sealing.” *Id.*

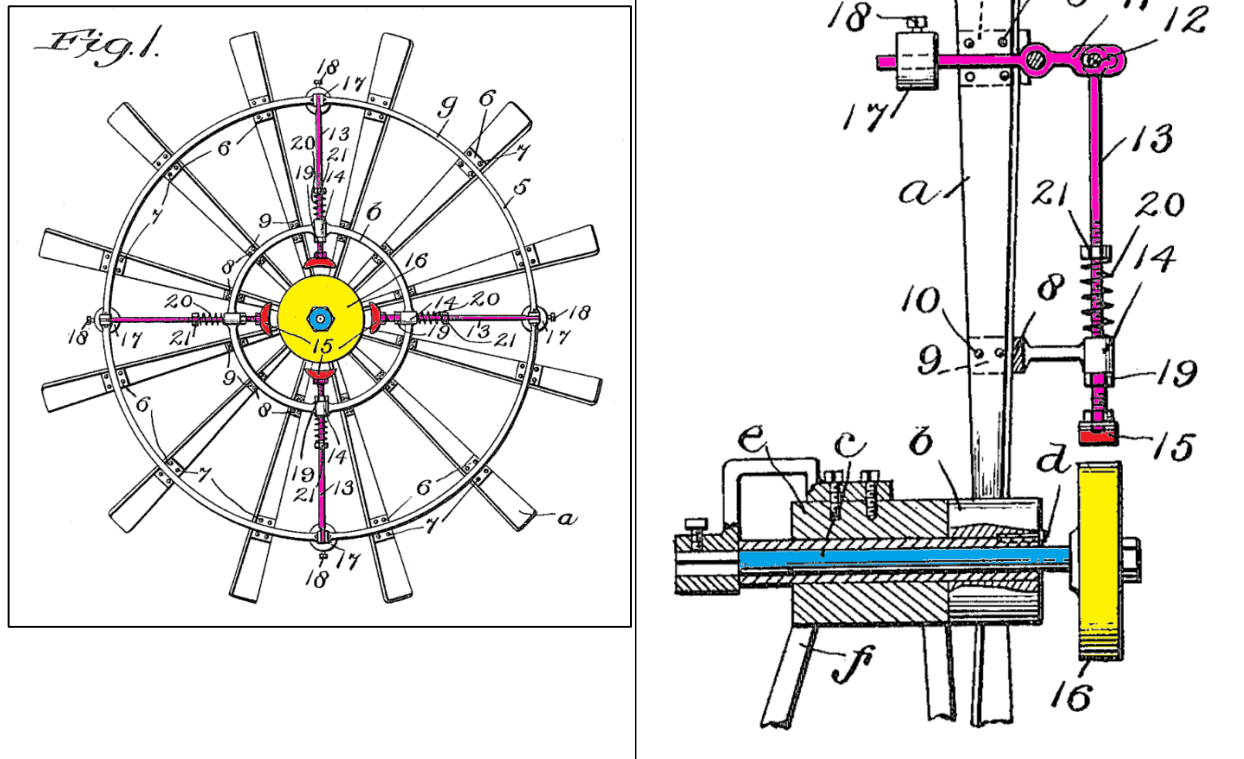
355. Finally, Hanxing discloses that “[m]ore than two screw holes are provided on the upper and lower clamping hoops 61/62, and bolts 10 [circled in orange in Hanxing Figure 4 above] passing through these screw holes will tightly press the steel sleeve against the main shaft 2 to ensure surface contact.” *Id.* at [0031]. The adjustable bolts 10 engaging four steel plates are radial displaceable and substantially symmetrical, being located around the center axis of the main shaft. The bolts 10 are displaceable between a passive position where sleeve 64 is located at a distance from a surface of the main shaft and an active position where the sleeve 64 is configured to be engaged with the main shaft 2.

356. It would have been well known to a POSITA that application of a friction force from torque clamps or friction brakes as taught by Signore or Weaver would result in the application of a radial force to the main shaft. This radial force can create a bending moment on the main shaft. Such a radial force and bending moment can damage the main shaft or other components of the wind turbine unless balanced by an equal and opposing force. Selecting the number and locations of

torque clamps or friction brakes would be a matter of design choice, and a POSITA would have recognized that the device taught by Hanxing provides a set of equally spaced and equal but opposite forces on the main shaft, resulting in a secure restraint of the main shaft without applying a bending force on the main shaft.

357. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver in view of Hanxing alone. However, my opinion is bolstered by the fact that at least three radially displaceable pressure mandrels, substantially symmetrical located around a center axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes were well known in the art. For example, this is corroborated by Bisbee:

358. **Bisbee:** Bisbee discloses a windmill brake comprising four pressure mandrels with tap shoes symmetrically arranged around a friction disc on the drive shaft.



Bisbee, Figures 1 and 2 (annotated).

359. More specifically, Bisbee discloses “[a] series of levers 11 [(pink in Bisbee Figures 1 and 2 above)] are fulcrumed on the annulus 5 and between the blades a. The ends of these levers are suitably connected such as by pin and slot connections 12, to the outer ends of rods 13, which rods are slidingly fitted in guides 14 carried by the inner annulus 8 and have at their inner ends friction shoes 15 [(red in Bisbee Figures 1 and 2 above)] arranged in the plane of a friction disk 16 [(pink in Bisbee Figures 1 and 2 above)] located concentrically at one end of the drive shaft c [(blue in Bisbee Figures 1 and 2 above)].” *Id.* at 1:53-67. “Weights 17 on the

power ends of the levers 11, operate to move the levers and rods, whereby, to effect frictional contact between the shoes and disk when the weights move outwardly under centrifugal force attained by the rotation of the propeller.” *Id.* at 1:67-79.

360. It would have been well known to a POSITA that application of a friction force from torque clamps or friction brakes as taught by Signore or Weaver would result in the application of a radial force to the main shaft. This radial force creates a bending moment on the main shaft. Such a radial force and bending moment can damage the main shaft or other components of the wind turbine unless balanced by an equal and opposing force. Selecting the number and locations of torque clamps or friction brakes would be a matter of design decision, and a POSITA would have recognized that well-known devices like those taught by Bisbee provides a set of equally space and equal but opposite forces on the main shaft, resulting an a secure restraint of the main shaft without applying a bending force on the main shaft.

361. Thus, a POSITA would find it obvious to include “at least three radial displaceable pressure mandrels, substantially symmetrical[ly] located around a centre axis of the main shaft, ends of the adjustable pressure mandrels facing the main shaft being furnished with the tap shoes” in the main shaft fixture of the Signore Application and Weaver in further view of Hanxing.

362. In light of the foregoing discussion, the elements of Claim 2 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Hanxing.

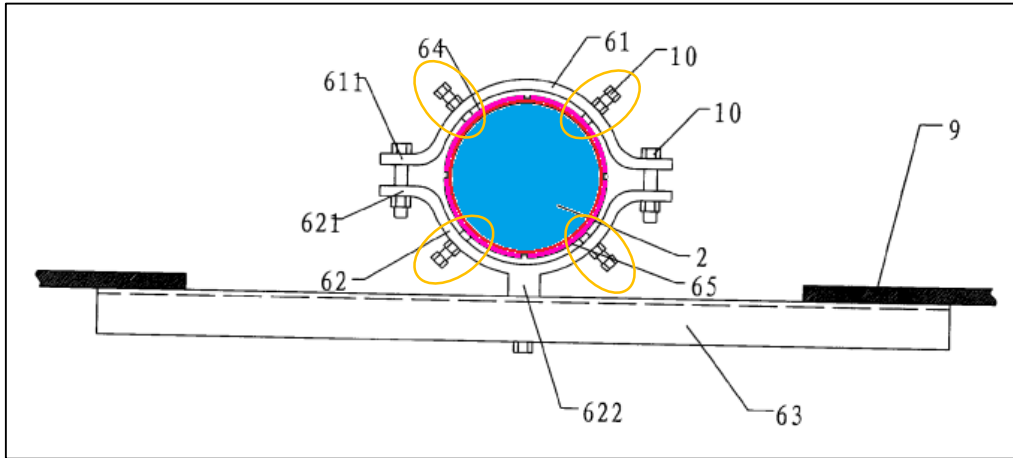
4. **Claim 5: “Main shaft fixture, according to claim 1, characterized in, that the adjustable pressure mandrels consists of threaded bolts whose opposing free ends facing the main shaft are furnished with tap shoes, and the threaded bolts cooperates with threaded holes in relevant sections of the main shaft fixture.”**

363. The main shaft fixture of Claim 1 is taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway. *See supra* XII.A.5.

364. Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway, further in view of Hanxing and/or Schulz teaches this element.

365. Weaver discloses “[h]ydraulic or ***mechanically*** operated friction brakes 518” that “are provided on opposing brake support flanges 519 extending in an essentially axial direction from an end 516 of half-spool member 401” and act to “clamp main shaft 402 and thereby inhibit rotation of shaft 402.” Weaver at [0017].

366. Hanxing discloses a clamp used for replacing a gearbox of a wind turbine with a single supporting main shaft.

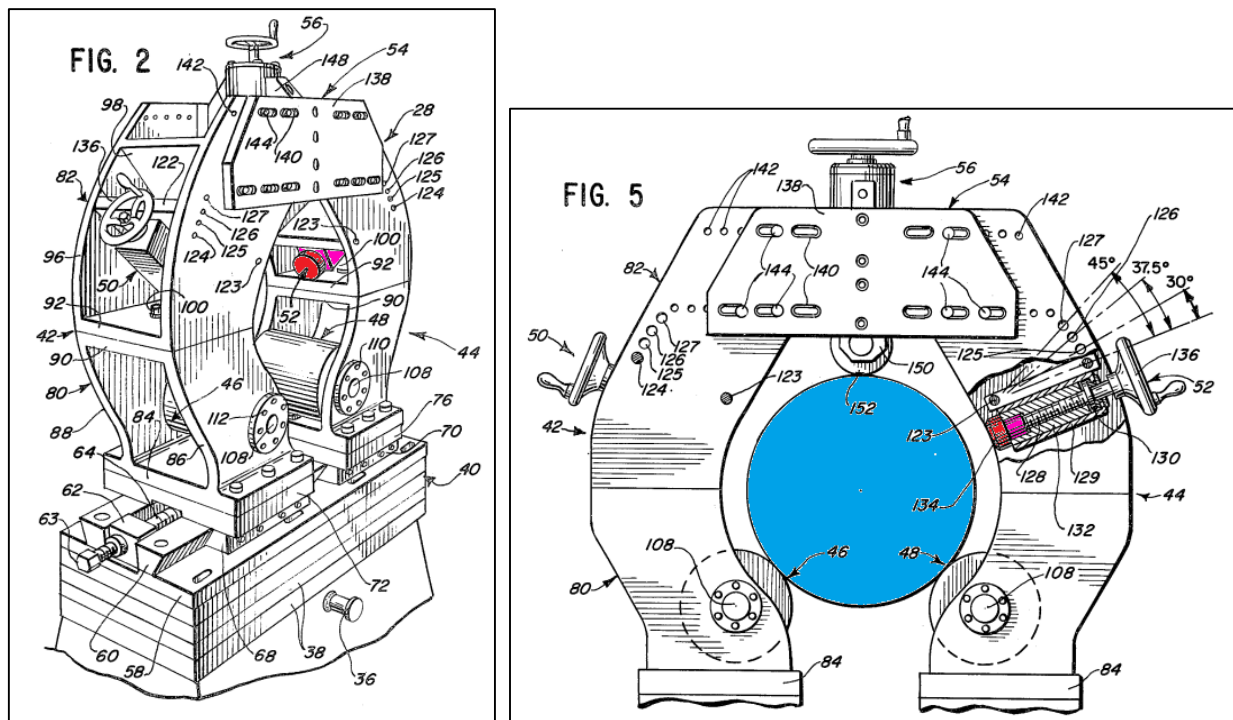


Hanxing, Figure 4 (annotated).

367. In order to adapt to the rotor shaft, Hanxing discloses “two arc-shaped steel plates 64 [pink in Hanxing Figure 4 above] can be installed inside each of the upper clamping hoop 61 and the lower clamping hoop 62, forming a steel sleeve with four steel plates 64” around the rotor shaft. Hanxing at [0031]. Hanxing further discloses that “a layer of soft wear-resistant material 65,” (red in Hanxing Figure 4 above), e.g., a brake pad, “can also be added inside the steel sleeve for better sealing.” *Id.*

368. Finally, Hanxing discloses the “[m]ore than two screw holes are provided on the upper and lower clamping hoops 61/62, and bolts 10 [circled in orange in Hanxing Figure 4 above] passing through these screw holes will tightly press the steel sleeve against the main shaft 2 to ensure surface contact.” *Id.* at [0031]. The adjustable bolts 10 engaging four steel plates are radial displaceable and substantially symmetrical, being located around the center axis of the main shaft.

369. In addition, Schulz discloses a shaft fixture for repairs to heavy rotor shafts used in transferring power to a power generation turbine, in particular rotor shafts (blue in Schulz Figure 5 below) for steam turbine electric generators, which “may weigh as much as 150 tons, and may be 35 feet long.” Schulz at 1:11-12; see *also id.* at 1:8-17.



370. More particularly, Schulz discloses a “head” with radially displaceable pressure mandrels with brake pads. *Id.* at 3:6-14. Schulz discloses “[b]rakes 50 and 52 [which] are identical [in] their construction.” *Id.* at 4:28. Schulz’s “brake housing

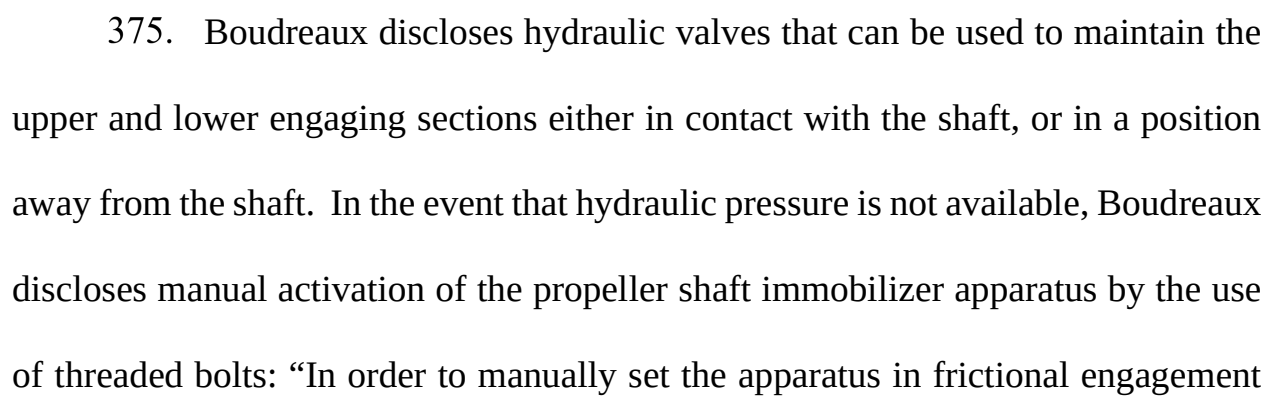
128 ... has a brake screw 129 rotatably mounted therein, which brake screw has a brake screw collar 130 secu[r]ed thereto in rotatable engagement with the housing and thereby retainingly holding the brake screw. An elongated brake nut 132 is threadedly mounted on the brake screw. The brake nut has a brake pad 134 [(red in Schulz Figures 2 and 5 above)] mounted on the end of the nut [(pink in Schulz Figures 2 and 5 above)].” *Id.* at 4:39-47. In order to operate the brakes to secure the rotor shaft, “[a] conventional wheel 136 is fixed to the brake screw to provide a convenient means for turning the screw for extension or retraction of the brake pad 134....” *Id.* at 4:47-52.

371. A POSITA would have been motivated in the relevant timeframe to combine the teachings of Hanxing and/or Schulz with the devices taught by Signore and Weaver in order to achieve a more secure and a more adaptable main shaft fixture that is capable of securely holding a wider variety of main shaft diameters and configurations. Further, a POSITA would have had a reasonable expectation of success because four pressure points provide a more solid grasp on the main shaft than two or three pressure points can provide because the four pressure points provide orthogonal forces to resist movement in all directions (for example vertical and horizontal – or 45 degrees, 135 degrees, 225 degrees, and 315 degrees, as taught by Hanxing). Also, by adjusting the extension and retraction of each pressure point, it is possible to adjust for minor variations in shaft size, geometry, height, or location.

372. It is my opinion that this element is rendered obvious by the combination of Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway, further in view of Hanxing and/or Schulz alone. However, my opinion is bolstered by the fact that adjustable pressure mandrels consisting of threaded bolts whose opposing free ends facing the main shaft are furnished with tap shoes, and the threaded bolts cooperate with threaded holes in relevant sections of the main shaft fixture were well known in the art. For example, this is corroborated by Boudreaux.

373. **Boudreaux**: Boudreaux discloses a shaft immobilizer used in the energy industry, in particular “[i]n the use of large boats, particularly in crew boats, in servicing the offshore oil and gas industry.” Boudreaux at 1:5-14.

374. The propeller shaft immobilizer apparatus of Boudreaux includes a “vertically disposed lower base section mounted fixedly to the floor portion of a boat,” and “an upper support base portion which is slidably mounted onto the lower base portion, with the ability to move upward and downward.” *Id.* at 2:66-3:2. The propeller shaft immobilizer apparatus of Boudreaux also includes “a lower and upper engaging means” (pink, respectively, in Boudreaux Figure 2, annotated below), that are “mounted on the upper base portion which are movable to frictionally engage the propeller [shaft] to be immobilized” using brake shoes (red in Boudreaux Figure 2 below). *Id.* at 3:2-5. The lower and upper engaging means are moved into



with shaft 11, the head of bolts 28 through 31 are rotated by a wrench or the like, which would cause bolts 28 through 31, since they are threaded through the floor 22 of apparatus 10, would lower the upper engaging section 38 and frictional engagement with shaft 11, and likewise raise lower engaging section 44 in frictional engagement, as seen in FIG. 4.” *Id.* at 7:58-8:10.

376. In light of the foregoing discussion, the claimed elements of Claim 5 would have been obvious to a POSITA as of the priority date of the ’578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann and further in view of Hanxing and/or Schulz.

5. Claim 15:

- a. **15[Pre]: “Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine”**

377. This element of Claim 15 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.a.

- b. **15[a]: “where the main shaft fixture is divided up into a number of sections for mounting on stable structural parts in a nacelle of a wind turbine, including a bottom frame of the nacelle”**

378. This element of Claim 15 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.b.

- c. **15[b]: “characterised in that the main shaft fixture comprises adjustable pressure mandrels with tap shoes, and”**

379. This element of Claim 15 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.c.

- d. **15[c]: “the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft”**

380. This element of Claim 15 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.d.

- e. **15[d]: “the adjustable pressure mandrels consisting of threaded bolts whose opposing free ends facing the main shaft are furnished with tap shoes, and the threaded bolts cooperates with threaded holes in relevant sections of the main shaft fixture”**

381. This element of Claim 15 is substantively identical to Claim 5 and my analysis is the same. *See supra* Section XII.B.4.

- f. **15[e]: “and in that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine”**

382. This element of Claim 15 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.e.

383. In light of the foregoing discussion, the claimed elements of Claim 15 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann and further in view of Hanxing and/or Schulz.

C. Ground 3: Claims 9, 11-12, and 16-17 are Rendered Obvious by the Combination of Signore and Weaver in View of Power Climber, Stegemann and/or Holloway Further in View of Cooper, Schaeffler, and/or Guerenbourg

1. A POSITA Would Have Been Motivated to Combine Signore and Weaver with Cooper, Schaeffler, and/or Guerenbourg with a Reasonable Expectation of Success

384. Signore and Weaver are concerned with uptower maintenance of a wind turbine. *See* Weaver [0001] (“This invention relates generally to the servicing of apparatus in *elevated* locations.”) *and* Signore [0058] (“The above-described systems and methods facilitate removing and/or replacing a gearbox *uptower* of the wind turbine without requiring removal of the nacelle, the rotor, and/or the drive shaft.”). Guerenbourg is likewise concerned with uptower maintenance of a wind turbine. *See* Guerenbourg at [0001] (“The invention further describes a wind turbine with a wind turbine main bearing and a method of performing maintenance on a wind turbine.”), [0017] (“[A] method of performing maintenance on such a wind turbine comprises the steps of halting a rotation of the shaft, operating a lifting arrangement to raise the shaft, and removing a bearing pad of the wind turbine main bearing from a bearing housing of the wind turbine main bearing.”). A POSITA would have recognized at the relevant time period that uptower component replacement includes not only gearbox replacement, as taught by Signore and Weaver, but also main bearing replacement, as taught by Guerenbourg. Both the gearbox and the main bearing are rotating components that wear over time and

require periodic replacement. Both gearbox and main bearing component replacement activities require the use of a large mobile crane unless a process and device can be provided to perform the activities up-tower without a large crane. The motivation to perform the work up-tower without a large mobile crane is similar whether replacing a gearbox or a main bearing, and a POSITA would have seen these two activities as analogous and complementary. Therefore, one of ordinary skill in the art would have been motivated at the time of application of the '578 Patent to combine the teachings of Signore, Weaver, and Guerenbourg to design a more adaptable and useful device that can facilitate repair and replacement of either the gearbox or the main bearing without the use of a large mobile crane.

385. Further, Signore and Weaver recognize that removing components from the nacelle is difficult and costly. *See* discussion of Signore and Weaver above (*supra* Section XII.A.1).

386. Like Signore and Weaver, Guerenbourg and Cooper recognize that removing components from the nacelle is difficult and costly. *See* Guerenbourg at [0005] (“**An external crane** with the necessary lifting capacity **presents a considerable additional expense....**”), [0017] (“An obvious advantage of the method according to the invention is the reduction in costs, since **an expensive external crane with high lifting capacity is not required.**”). Cooper discloses that split bearings provide “Significant Cost Savings at time of Installation” “Ease of

Replacement,” “Reduce[d] Downtime,” and “Increase[d] Maintenance Man-Hour Efficiency.” Cooper at 2 of 3; *see also id.* (providing a cost savings comparison). Further, Cooper discloses that its split roller bearings include split roller bearings mounted on pillow blocks, *id.*, and that are intended for use in “Power Generation,” including in “Wind Turbines.” *Id.*

387. Schaeffler similarly recognizes that removing components from the nacelle is difficult and costly, and discloses split spherical roller bearings that offer “[c]ost[] savings through rapid bearing replacement at difficult to access bearing locations.” Schaeffler at 1 of 29. Schaeffler discusses that “[s]plit spherical roller bearings are principally used where the replacement of unsplit spherical roller bearings would require costly additional work, involving the removal of gears or couplings, the dismounting of drives or the dismantling of shaft power trains. The use of split spherical roller bearings reduces the downtime of machinery and plant.” *Id.* at 4 of 29.

388. A POSITA would have recognized at the time of the filing of the application for the ’578 Patent that the use of split bearings provides additional cost savings, and that the use of such bearings is consistent with and compatible with the use of a lifting device such as that taught by Guerenbourg, or by Signore as modified by Weaver and Guerenbourg, to raise one end of the shaft and facilitate bearing replacement.

389. For these reasons, a POSITA would have been motivated to combine Signore and Weaver with Cooper, Schaeffler, and/or Guerenbourg. Further, a POSITA would have had a reasonable expectation of success because the use of split bearings as replacements for wind turbine main bearings was a known method for performing in-situ bearing replacement, and the type of bearings taught by Cooper and Schaeffler are compatible with the devices taught by Signore and Weaver and were known to be useful as replacements of wind turbine main bearings. The split bearings of Cooper and Schaeffler and the jack of Guerenbourg are conventional mechanical elements used as a POSITA would expect. The use of these components, together with the main shaft fixtures taught by Signore and Weaver, provides expected benefits that would have been obvious to a POSITA, and does not provide any surprising or unexpected results when combined with a main shaft fixture.

2. **Claim 9: “Main shaft fixture according to claim 1, characterized in, that it comprises one of a multi-part needle bearing, roller bearing, ball bearing consisting of a multi-part inner ring fastened to the main shaft, and a therewith cooperating multi-part outer ring consisting of bowed subsegments corresponding to a number of tap shoes, mounted on opposing side of the tap shoes facing an inner ring, which in the active position of the adjustable pressure mandrels form an outer ring at a distance from an outer periphery of the multi-part inner ring, and where an appropriate number of needle rollers, rollers, or balls are arranged between the inner ring and the outer ring, and where means are present for retaining needles, rollers, or balls in position between the inner ring and outer ring.”**

390. The main shaft fixture of Claim 1 is taught by Signore Application in view of Power Climber, Stegemann, and/or Holloway. *See supra* Section XII.A.5.

391. Signore and Weaver in view of Cooper and/or Schaeffler teach this element.

392. Cooper discloses a suite of split roller bearings, which include “Made to Order Services for specific engineering solutions.” Cooper at 2 of 3. The split roller bearings disclosed by Cooper include split roller bearings mounted on pillow blocks, *id.*, and that are intended for use in “Power Generation,” including in “Wind Turbines.” *Id.*



393. Schaeffler discloses split spherical roller bearings that offer “[c]ost[] savings through rapid bearing replacement at difficult to access bearing locations.” Schaeffler at 1 of 29.

394. Furthermore, Weaver teaches the use of a bearing in place of the shaft-restraining members to allow rotation of the shaft above a predetermined torque.

Weaver at [0018]. This embraces the claimed element of “one of a multi-part needle bearing, roller bearing, ball bearing” as part of the main shaft fixture. A POSITA would recognize that the only way to install such a bearing as part of the main shaft fixture would be to utilize a split bearing as taught by Cooper and Schaeffler. The split bearings taught by Cooper and Schaeffler disclose that the bearing consists of “a multi-part inner ring fastened to the main shaft, and therewith cooperating multi-part outer ring consisting of bowed subsegments.” Weaver describes that “surfaces 520 are Teflon(TM)-covered or provided with roller bearing surfaces....” Weaver at [0018]. In providing roller bearing surfaces for surfaces 520, a POSITA would find it advantageous to utilize split bearing such as those taught by Cooper and Schaeffler, at least because split bearings are easier are more cost effective to replace. The split bearings taught by Cooper and Schaeffler each have an inner race in two pieces, which corresponds to the “multi-part inner ring” in Claim 9, and an outer race in two pieces, which corresponds to the “multi-part outer ring” in Claim 9. Each of these two sets of inner and outer bearing races correspond to the element in Claim 9 of “bowed subsegments corresponding to a number of tap shoes, mounted on opposing side of the tap shoes facing an inner ring,” *i.e.*, a set of inner and outer bearing races together is a bowed subsegment. Further, these two sets of inner and outer rings of the split bearings taught by Cooper and Schaeffler correspond to the two surfaces 520, as shown by Weaver, in the situation where roller bearing surfaces

are provided for surfaces, as described by Weaver, *i.e.*, a set of inner and outer bearing races together corresponds to one of the two surfaces 520. Since Weaver already suggests that surfaces 520 can be “provided with roller bearing surfaces,” it would have been obvious to a POSITA to have utilized the specific split bearing structure taught by either Cooper or Schaeffler, or a similar split bearing structure, to achieve the device described by Weaver. Weaver provides the general description of a bearing incorporated in a main shaft fixture, and Cooper and Schaeffler provide the specific details of “one of a multi-part needle bearing, roller bearing, ball bearing” (specifically, Cooper shows a roller bearing). Weaver shows “roller bearing surfaces” (element 520) that has “bowed subsegments.” Cooper and Schaeffler also show “bowed subsegments” that are consistent with those taught by Weaver. Therefore, it would have been obvious for a POSITA at the time of the filing of the application for the ’578 Patent to have utilized a roller bearing as taught by Weaver and specifically to utilize a split bearing with a multi-part inner ring and a multi-part outer ring as taught by Cooper and/or Schaeffler.

395. In light of the foregoing discussion, the claimed elements of Claims 9 would have been obvious to a POSITA as of the priority date of the ’578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann and further in view of Cooper and/or Schaeffler.

3. Claim 11: “Main shaft fixture, according to claim 10, characterised in, that the rotor lock consists of a flange

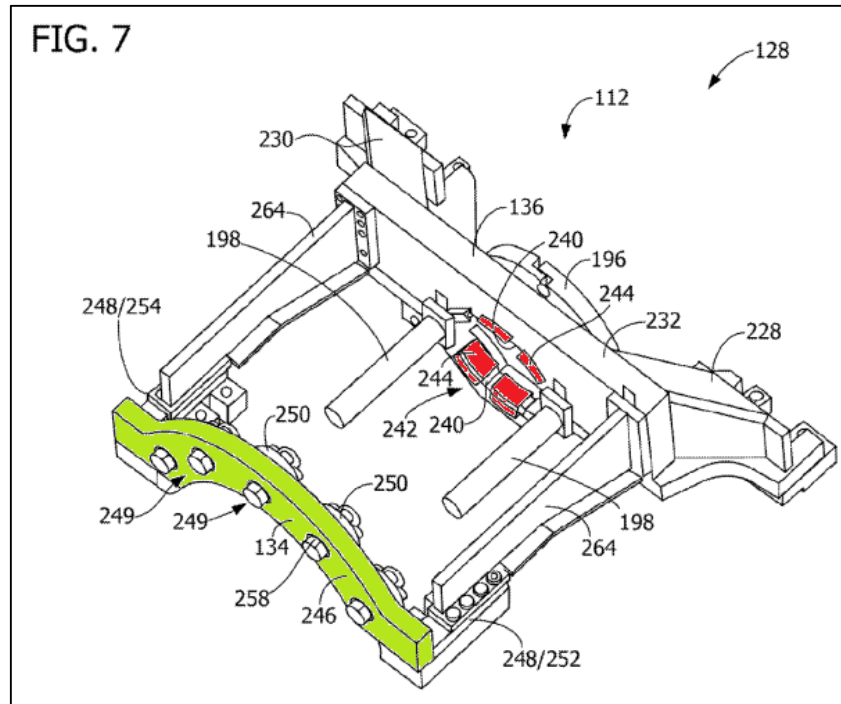
element, whose bolt circle geometry corresponds to a bolt circle geometry on the rotor, the flange element being fastened to a first end of two first beam-shaped brackets extending parallel with, and on each side of the main shaft, the beam shaped brackets belonging to the main shaft fixture, and where a second end of the beam-shaped brackets are pivotally mounted with horizontally oriented bolt connections, on other beam-shaped brackets belonging to the main shaft fixture, which are adapted to be anchored on the bottom frame of the nacelle.”

396. The main shaft fixture of Claim 10 is taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway. *See supra* Section XII.A.12. Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway further in view of Schaeffler and/or Guerenbourg teach this element.

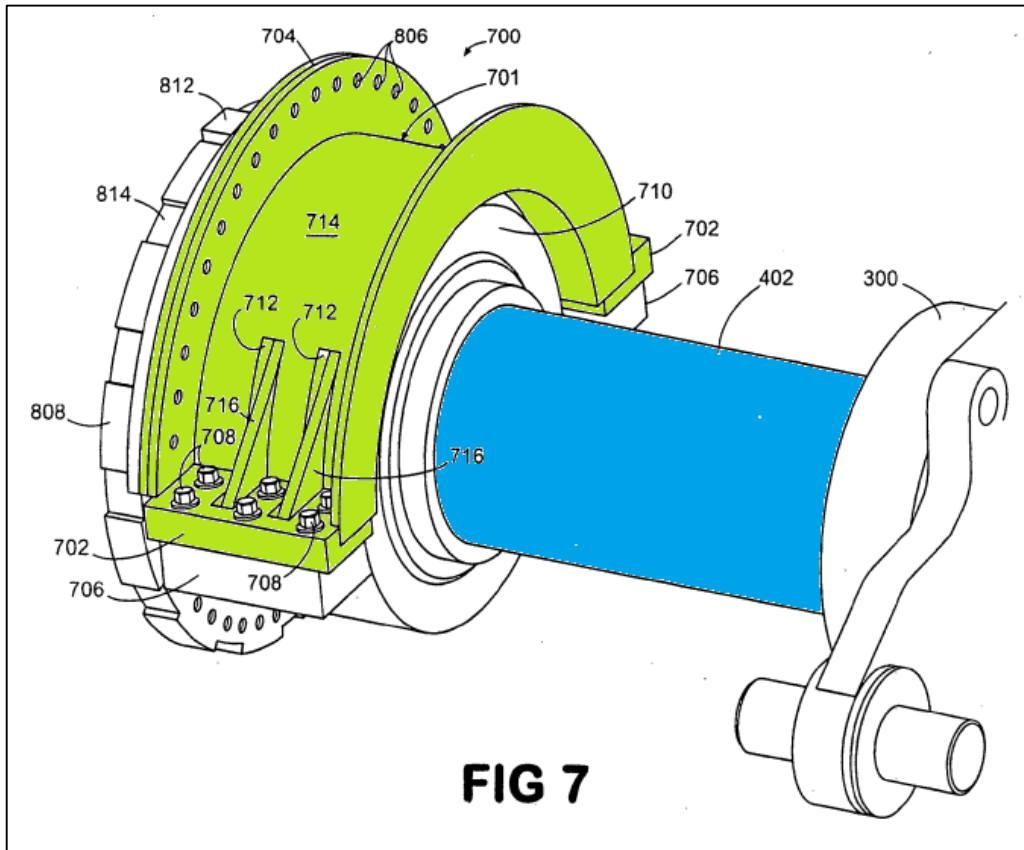
397. Further, a rotor lock of Claim 1 consisting of a flange element, whose bolt circle geometry corresponds to a bolt circle geometry on the rotor is taught by Signore and Weaver.

398. For example, Signore discloses a “shaft support assembly 128,” pictured in Signore Figure 7 below, that “includes a drive shaft locking assembly 134 [(green in the figure below)].” Signore at [0031]. Signore’s “[s]haft locking assembly 134 is adapted to be coupled to support frame 16 and to rotor locking member 74 to facilitate limiting a rotation of drive shaft 24 about drive shaft axis 66.” *Id.*; *see also id.* at [0022] (describing the rotor locking member 74 on drive shaft 24 that mates with the drive shaft locking assembly 134). Signore’s shaft

locking assembly 134 consists of a flange element, whose bolt circle geometry corresponds to a bolt circle geometry on the rotor.



399. Weaver also discloses a rotor lock whose bolt circle geometry corresponds to a bolt circle geometry on the rotor, for fixation of a wind turbine. Weaver discloses a rotor lock that employs bolts placed through the rotor lock and the rotor flange via mating holes in order to lock rotation of the rotor shaft.



400. More specifically, Weaver discloses that “[b]y fastening semi-annular member 704 to mounting flange 806, half-spool member 701 to semi-annular member 704, and half-spool member 701 to mounting flanges 706 or to bolts 708 therein [(704 and 701 green in Weaver Figure 7 above)], shaft 402 [(blue in Weaver Figure 7 above)] is effectively restrained from tilting and its rotation effectively inhibited. Gearbox 300 can then be safely removed and replaced.” *Id.* at [0023].

401. A POSITA would understand that it would be advantageous to be able to expand the scope of the main shaft fixture of Signore and Weaver to also facilitate the repair or replacement of the main bearing. A POSITA would have recognized at the relevant time period that up-tower component replacement includes not only

gearbox replacement, as taught by Signore and Weaver, but also main bearing replacement, as taught by Guerenbourg. Both the gearbox and the main bearing are rotating components that wear over time and require periodic replacement. Both gearbox and main bearing component replacement activities require the use of a large mobile crane unless a process and device can be provided to perform the activities up-tower without a large crane. The motivation to perform the work up-tower without a large mobile crane is similar whether replacing a gearbox or a main bearing, and a POSITA would have seen these two activities as analogous and complementary. Therefore, one of ordinary skill in the art would have been motivated as of the priority date of the '578 Patent to combine the teachings of Signore and Weaver with Schaeffer and/or Guerenbourg to design a more adaptable and useful device that can facilitate repair and replacement of either the gearbox or the main bearing without the use of a large mobile crane.

402. Schaeffler discloses a general procedure for the fitting of a split spherical roller bearing. *See* Ex. 1020 at 9 of 29. The process described includes “[s]upport[ing] the weight of the rotor” (*e.g., raising the end of the rotor shaft* to create clearance for the bearing replacement process), “[d]ismount[ing] the old bearing” (including “cut[ting] through” the “unsplit bearing” to be replaced), “[p]lac[ing] the outer ring half [of the split roller bearing] in the lower section of the housing and align[ing] it with the inner ring mounted on the shaft, then screw[ing]

FIG 2

FIG 2 is a cross-sectional view of a mechanical assembly. The assembly includes a central shaft (18) passing through a housing (11). A seal (13) is located at the interface between the shaft and the housing. A small component (19) is highlighted with an orange circle. A dimension line (D) indicates a distance.

404. More specifically, Guerenbourg discloses “**a lifting arrangement such as a jack** [(orange in Guerenbourg Figure 2 above)] **for raising a relevant part such as the main shaft** to reduce the load on the main bearing in order to facilitate removal, insertion or maintenance of a bearing pad in the lower region of the bearing housing.” *Id.* at [0032]; *see also id.* at [0053] (“[A] jack 22 is mounted on the Nacelle bedplate, and can be used to raise the main shaft 13 by a sufficient amount to allow one of the lower bearing pads 2 to be removed.”). Guerenbourg describes this lifting arrangement, for example, as “a simple jack, [which,] as the skilled person will appreciate, is quite easily installed in a wind turbine Nacelle housing.” *Id.* at [0032]. Guerenbourg further explains that “[u]sing such a jack, the main shaft or rotor can be lifted and fixed to support the load and hold the shaft stable. Then, since the bearing pads are no longer under any load, they can easily be replaced in one operation.” *Id.*

405. While Guerenbourg does not disclose a specific pivot point or hinge for use in lifting and then lowering the shaft during the main bearing replacement process, Guerenbourg discloses lifting only one end of the shaft. A POSITA would understand that while Guerenbourg does not expressly disclose a corresponding pivot point on the other axial end of the shaft, a supporting structure with a horizontal pivot point would be required to secure the shaft and, if necessary, allow it to tilt, while being raised at one end. A POSITA would find it obvious that lifting one the

end of the shaft would require the main shaft fixture, which is secured to the nacelle, to provide a hinge, or pivot point, to allow the main shaft fixture to continue to secure the shaft and fix it against undesired vertical or horizontal movement while also being secured to a structural element of the nacelle. If a pivot point is not provided, and the shaft is cantilevered on the end that is not being lifted, it would require the shaft to deflect and bend. Wind turbine main shafts are very large and rigid objects that cannot readily be bent or deflected. Therefore, a POSITA would recognize that the end of the shaft not being lifted would need to be provided with a pivot point.

406. Regarding the “beam shaped brackets” recited in claim 11, Signore shows beams 264, described in the Detailed Description as “a plurality of braces.” Signore at [0056]. These braces meet the claimed “beam shaped brackets” of Claim 11. A POSITA would have been motivated to add pivots to these braces, as described above, in order to allow the main shaft to tilt as it is lifted during replacement of a gearbox or a main bearing. Furthermore, the pivots and braces need to be attached to *something*, and the bottom frame of the nacelle would be an obvious design choice for a POSITA because the nacelle floor is a strong and rigid structure made of nodular cast iron that would provide a stout and convenient attachment point for the main shaft fixture. Because the main shaft fixture needs to be placed some distance above the nacelle floor, it would be a necessary and obvious design choice for a POSITA to provide “other beam-shaped brackets” to connect to

the floor of the nacelle. The two beam-shaped brackets extending parallel to the main shaft, the pivots on the brackets, and the other beam-shaped brackets that attach to the nacelle floor all perform their ordinary functions in a way that would have been expected by a POSITA, that being to hold the shaft fixture in place in the nacelle, allow it to tilt during the process of raising the main shaft, and secure it to a secure hard point on the nacelle floor. They do not provide any surprising or unexpected benefits to the main shaft fixture.

407. In light of the foregoing discussion, the claimed elements of Claim 11 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann and further in view of Schaeffler and/or Guerenberg.

4. **Claim 12: “Main shaft fixture, according to claim 11, characterised in, that at least one actuator is located nearest the rotor lock between the bottom frame of the nacelle and an adjacent side of the first beam-shaped brackets facing the bottom frame, the actuator is displaceable between a first passive outer position and an active outer position where the flange element is displaced vertically.”**

408. The main shaft fixture of Claim 11 is taught by Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway, further in view of Schaeffler and/or Guerenbourg. *See supra* Section XII.C.3. Signore and Weaver in view of Power Climber, Stegemann, and/or Holloway further in view of Schaeffler and/or Guerenbourg teach this element.

409. As discussed above, Schaeffler and Guerenbourg both teach raising the shaft at one end to facilitate repair. *See supra* XII.C.3. Further, Guerenbourg expressly discloses using an actuator (i.e., jack 22) to raise the shaft. *See supra* XII.C.3.

410. Further, an actuator is a component of a machine that produces force, torque, or displacement, when an electrical, pneumatic or hydraulic input is supplied to it. Actuators have been a well-known element of hydraulic, pneumatic, and electro-mechanical systems for many decades and a POSITA would find it obvious to use an actuator to assist with raising the shaft in the way taught by Schaeffler and Guerenbourg.

411. In light of the foregoing discussion, the claimed elements of Claim 12 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann and further in view of Schaeffler and/or Guerenberg.

5. **Claim 16:**

- a. **16[Pre]: “Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine,”**

412. This element of Claim 16 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.a.

- b. **16[a]: “where the main shaft fixture is divided up into a number of sections for mounting on stable structural**

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**parts in a nacelle of a wind turbine, including a bottom
frame of the nacelle**

413. This element of Claim 16 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.b.

- c. **16[b]: “characterized in[] that the main shaft fixture comprises adjustable pressure mandrels with tap shoes, and”**

414. This element of Claim 16 is substantively identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.c.

- d. **16[c]: “the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft and”**

415. This element of Claim 16 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.d.

- e. **16[d]: “in that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine, and”**

416. This element of Claim 16 is identical to Claim 1 and my analysis is the same. *See supra* Section XII.A.5.e.

- f. **16[e]: “further comprising a rotor lock for fixation of a rotor of the wind turbine, ”**

417. This element of Claim 16 is identical to Claim 10 and my analysis is the same. *See supra* Section XII.A.12.

- g. **16[f]: “wherein the rotor lock consists of a flange element, whose bolt circle geometry corresponds to a bolt circle geometry on the rotor, the flange element being fastened to a first end of two first beam-shaped brackets extending parallel with, and on each side of the main shaft, the two first beam shaped brackets belonging to the main shaft fixture, and where a second end of the two first beam shaped brackets are pivotally mounted with horizontally oriented bolt connections, on other brackets belonging to the main shaft fixture, which are adapted to be anchored on the bottom frame of the nacelle”**

418. This element of Claim 16 is substantively identical to Claim 11 and my analysis is the same. *See supra* Section XII.C.3.

6. **Claim 17: “Main shaft fixture, according to claim 16, wherein at least one actuator is located nearest the rotor lock between the bottom frame of the nacelle and an adjacent side of the first beam shaped brackets facing the bottom frame, the actuator is displaceable between a first passive outer position and an active outer position where the flange element is displaced vertically.”**

419. This element of Claim 17 is identical to Claim 12 and my analysis is the same. *See supra* Section XII.C.4.

420. In light of the foregoing discussion, the claimed elements of Claim 16 would have been obvious to a POSITA as of the priority date of the '578 Patent as taught by the combination of Signore and Weaver in view of Power Climber, Holloway, and/or Stegemann and further in view of Cooper, Schaeffler, and/or Guerenbourg.

D. Ground 4: Claims 1 and 3-17 Are Anticipated by the '518 Patent

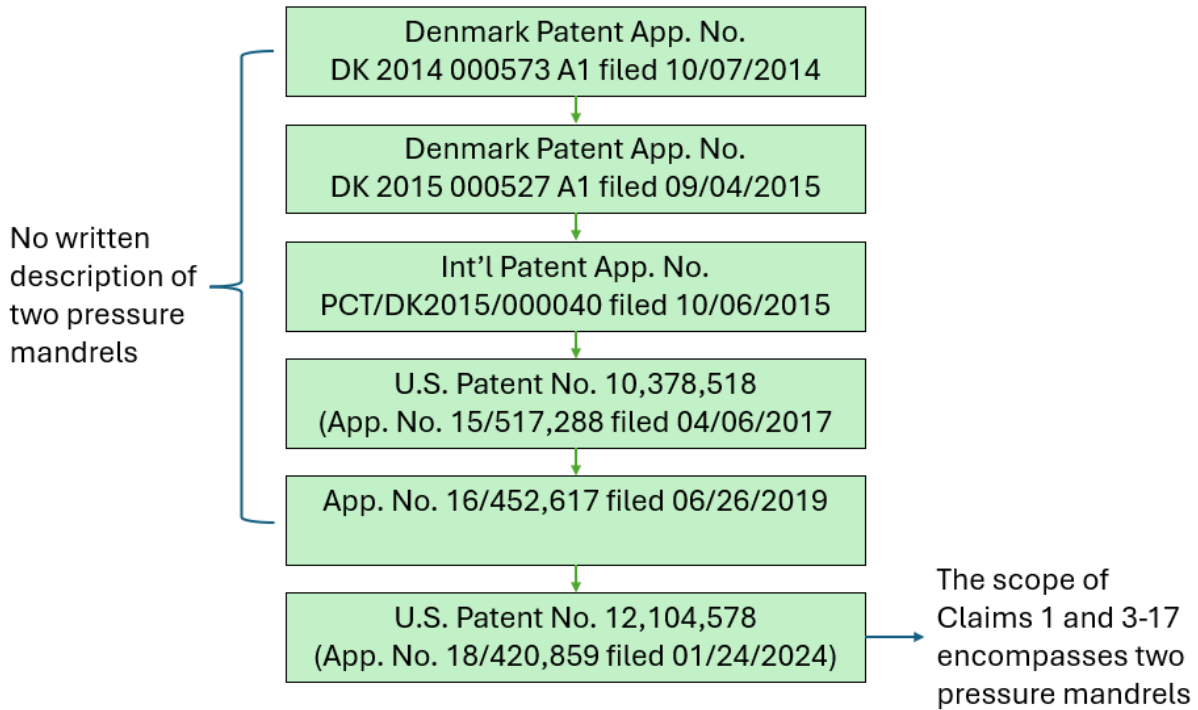
1. The '518 Patent is Prior Art to Claims 1 and 3-17 of the '578 Patent

421. The '578 Patent asserts a chain of priority including two U.S. patent applications and an international patent application: U.S. Patent Application No. 16/452,617 (U.S. Patent Pub. No. 2019/0316569A1) (the "'617 App.") (Ex. 1032); U.S. Patent Application No. 15/517,288 (U.S. Patent Pub. No. 2017/0306930A1) (the "'288 App.") (Ex. 1033);²⁷ and International Patent Application No. PCT/DK2015/000040 (International Pub. No. WO/2016/055065 A1) (the '040 App.") (Ex. 1034) (the '617 App., the '288 App., and the '040 App., collectively, the "Parent Applications"). See '578 Patent at 1:6-15.²⁸ The chain of priority is illustrated in the following flow chart:

²⁷ The '288 App. was granted as the '518 Patent.

²⁸ The '040 App. also claims priority to two Denmark Patent Applications. I have reviewed machine translations of these applications and they do not change my opinions herein.

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422. These Parent Applications share a similar specification with the '578 Patent. Importantly, the Parent Applications exclusively disclose using **three** or more adjustable pressure mandrels. *See* '617 App. at [0009] ("It is by the invention realized that this is possible by a main shaft fixture of the nature specified in the introduction, which is characterized by that the main shaft fixture comprises **at least three** radial displaceable pressure mandrels...."); '288 App. at [0008] (same); '040 App. at 3:1-3 (same).

423. Further, the figures in these Parent Applications exclusively show **three** or more (specifically, four) pressure mandrels. *See* '617 App. at [0037] ("As it appears from FIG. 2, the multi-part frame 14 and cross member 16 comprise in total **four** pressure mandrels 18 symmetrically placed around the main shaft 2, with tap

shoes 20 that are engaged onto the main shaft 4 in order to fix it in place.”); ’288 App at [0036] (same); ’040 App. at 7:29-32 (same).

424. These Parent Applications do not disclose an apparatus having ***fewer than three*** adjustable pressure mandrels. Because the specifications and exemplified embodiments never disclose or exemplify any embodiments with fewer than three adjustable pressure mandrels, a POSITA would not understand the inventors to possess embodiments with only ***two*** adjustable pressure mandrels. The distinction between two versus at least three pressure mandrels was confirmed by the applicant during prosecution of the ’518 Patent. In response to a rejection over Signore, the applicant argued that “Signore does not disclose radially displaceable pressure mandrels, as Signore is not concerned with adaptability to a number of various diameter or conical main shafts. As such, Signore would not provide a reason for one of ordinary skill to use ***at least 3*** independent displaceable pressure mandrels. If Signore were to be viewed in combination with Weaver, the person of ordinary skill in the art would use the ***only two*** shaft restricting devices.” Ex. 1006 (Prosecution History of ’518 Patent), at 68 (October 1, 2018 Applicant Arguments/Remarks Made in an Amendment, at 7). In other words, the applicant argued during prosecution that there was a meaningful distinction between “***at least 3***” versus “***only two***” pressure mandrels, and that the specification’s disclosure was limited to “at least 3” pressure mandrels. Specifically, the applicant argued that the

use of “at least three” pressure mandrels was associated with the goal of adaptability with main shafts of varying diameters or that are conical. The problem is that the Parent Applications (like the ’578 Patent) **are** concerned with adaptability to shafts of varying shapes and sizes. *See, e.g.*, ’518 Patent at 2:11-38 (“[I]t is the purpose of the invention the specify a main shaft fixture that provide a more universal application in relating to shaft geometry....”); *id.* at 6:32-47 (asserting the invention “can assume other embodiments than disclosed” as long as “such do not change the inventive aspect that is comprised of...caus[ing] the fixture 10 to be usable regardless of the geometry of the main shaft...”). The Patent Applications do not explain how the desired adaptability can be achieved with just **two** pressure mandrels—instead, the applicant argued a POSITA would use two only if it did not desire such adaptability.

425. Nevertheless, during prosecution of the ’578 Patent, the applicant amended the specification in a preliminary amendment and **removed** a limiting disclosure of “at least three” pressure mandrels:

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Please amend paragraph [0009], on page 3 of the description, as follows:

[0009] It is by the invention realized that this is possible by a main shaft fixture of the nature specified in the introduction, which is characterised by that the main shaft fixture comprises adjustable at least three radial displaceable pressure mandrels with tap shoes, substantially symmetrical located around the centre axis of the main shaft, the ends of said pressure mandrels facing the main shaft are furnished with a tap shoe, and said pressure mandrels being displaceable between a passive, withdrawn lockable position where the tap shoes are configured to be located at a distance from the surface of the main shaft and an advanced lockable position where the tap shoes are configured to be engaged with the main shaft and mounting facilities suitable for a lightweight crane.

Exhibit 1002 ('578 Prosecution History) at 133 (January 24, 2024 Preliminary Amendment, at 2). The intent of the January 24, 2024 amendment may have been to broaden the scope of the specification such that it was no longer limited to “at least three” pressure mandrels.

426. At the same time, the applicant amended the claims. Ultimately, the full scope of Claims 1 and 3-17 is broad enough to encompass the incorporation of **two** pressure mandrels. Claim 1 recites that “the main shaft fixture comprises adjustable pressure mandrels with tap shoes...” without limiting its scope to **at least three** pressure mandrels. '578 Patent at Claim 1. This is consistent with dependent Claim 2, which must be of narrower scope than Claim 1, and recites “that the adjustable pressure mandrels with tap shoes comprise **at least three** radial

displaceable pressure mandrels....” *Id.* at Claim 2. But Claim 2 is the only claim of the ’578 Patent that is restricted to at least three pressure mandrels. Claims 3-14 also depend from Claim 1, but do not restrict the number of pressure mandrels and therefore the full scope of those claims, like Claim 1, is broad enough to encompass “two or more” pressure mandrels. Similarly, independent Claims 15 and 16 both recite that “the main shaft fixture comprises adjustable pressure mandrels with tap shoes” without otherwise restricting the number of pressure mandrels. Claim 17 depends from Claim 16 and does not restrict the number of pressure mandrels. Thus, the full scope of Claims 15-17 is also broad enough to encompass “two or more” pressure mandrels.

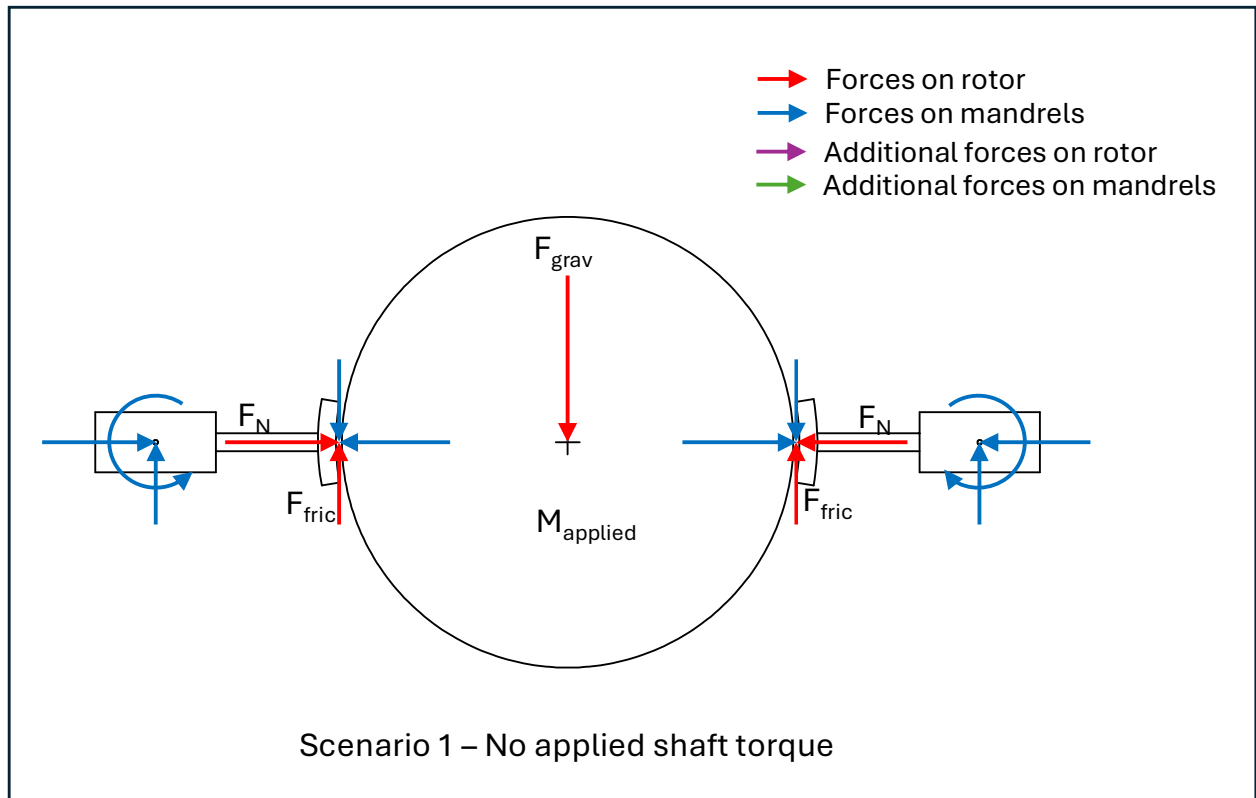
427. A POSITA at the relevant time period would recognize that at least three pressure mandrels provides a more secure and more adjustable attachment point for securing the main shaft. This is particularly true to better adapt to shafts of varying geometries. The use of at least three mandrels provide the advantage of more readily adapting to main shafts of different diameters, or with different shaft geometries. If only two mandrels are utilized, they must be perfectly aligned in diametric opposition on the main shaft, and at the precise height of the main shaft centerline. By using three mandrels, the friction brakes and mandrels are more easily adjusted to provide a secure hold on the main shaft even if the shaft diameter or shaft height is not exactly what was expected.

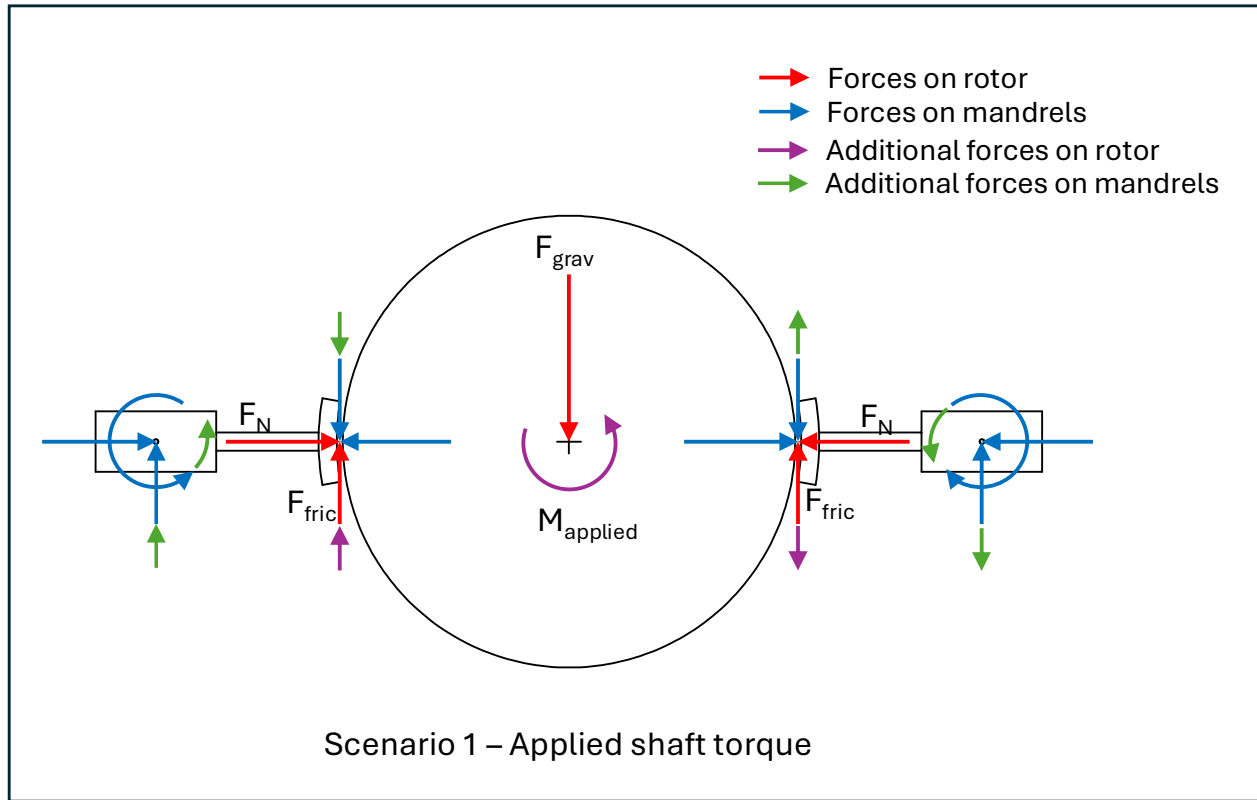
428. The distinction between using two pressure mandrels versus three or more pressure mandrels can be further appreciated with reference to the free-body diagrams below depicting the forces and moments that must be borne by the mandrels in each case.²⁹ The first diagram below depicts the forces and moments borne by a 2-mandrel device, both with and without torque applied to the main shaft (for example, in the case that the blades are still attached to the wind turbine and torque developed by the blades is resisted by the main shaft fixture). The second diagram shows the same free-body diagrams for the case where three mandrels are utilized. It can be appreciated from the first diagram that forces acting on the main shaft are shown as red arrows and forces and moments acting on each mandrel are shown in blue. It can be seen that a significant normal force (F_N) must be applied by the mandrel on the main shaft in order to be able to develop enough friction force

²⁹ Note that the diagrams show the forces expected during replacement of a main bearing. In the case of gearbox replacement, gravity forces may actually act in an upward direction on the main shaft because of the main bearing acting as a fulcrum against the weight of the rotor. Additionally, the external torque applied to the main shaft may be clockwise or counterclockwise, depending on the configuration of the wind turbine blades. The logic of two versus three mandrels is similar for any of these variations.

(F_{fric}) to support the weight of the main shaft, and possibly the entire wind turbine rotor. This friction force (F_{fric}) is borne by each mandrel as a bending moment, and the mandrels must be designed with significant bending resistance in order to withstand a very high bending moment. For the case where a torque load is applied to the main shaft (M_{applied}), for example by wind acting on the blades to develop torque, the torque-related forces and moments acting on the main shaft are shown in purple, and those acting on the mandrels to balance the external torque load are shown in green. In this case, the bending moment on the left mandrel is increased and the net bending moment acting on the right mandrel are decreased. In this case, the left mandrel would need to be even stronger to withstand the bending moments imposed by both gravity and torque applied to the main shaft. The mandrel would need to be very strong, indeed.

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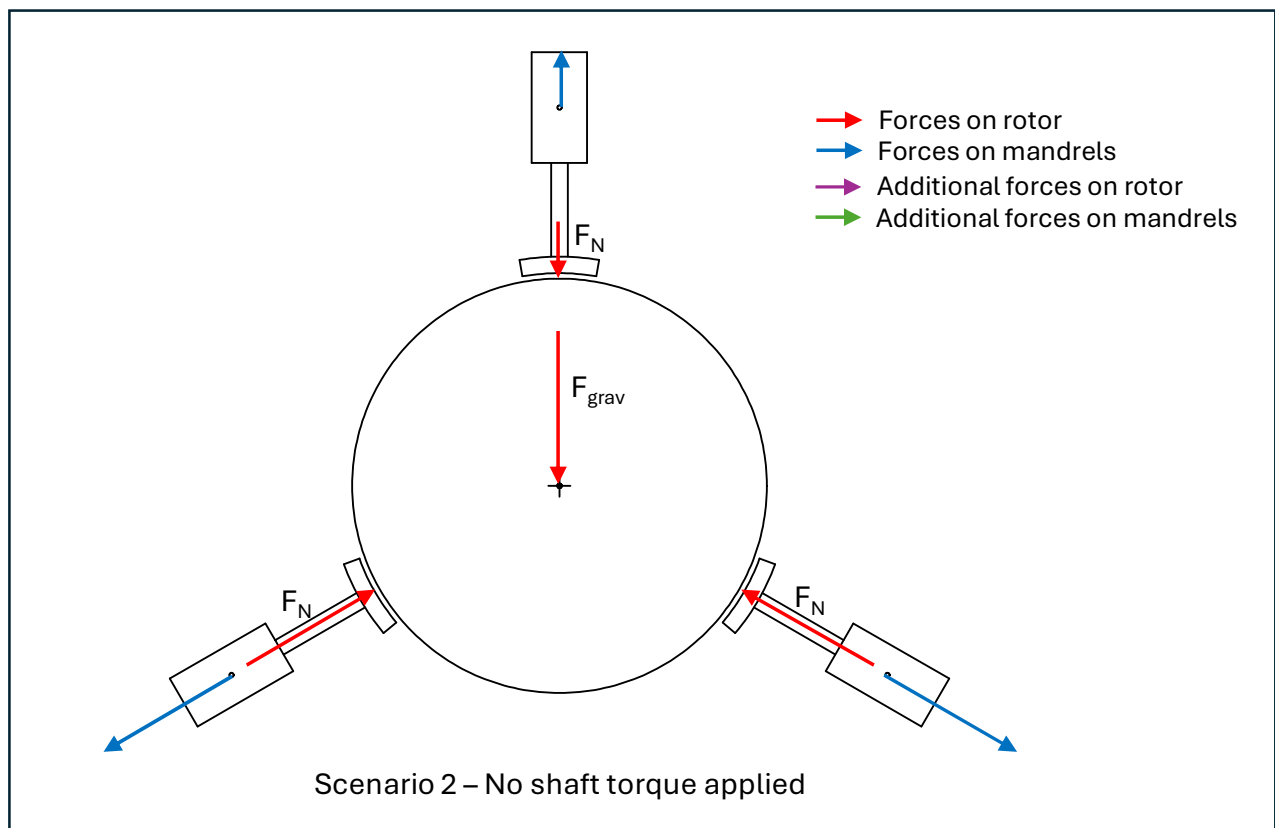


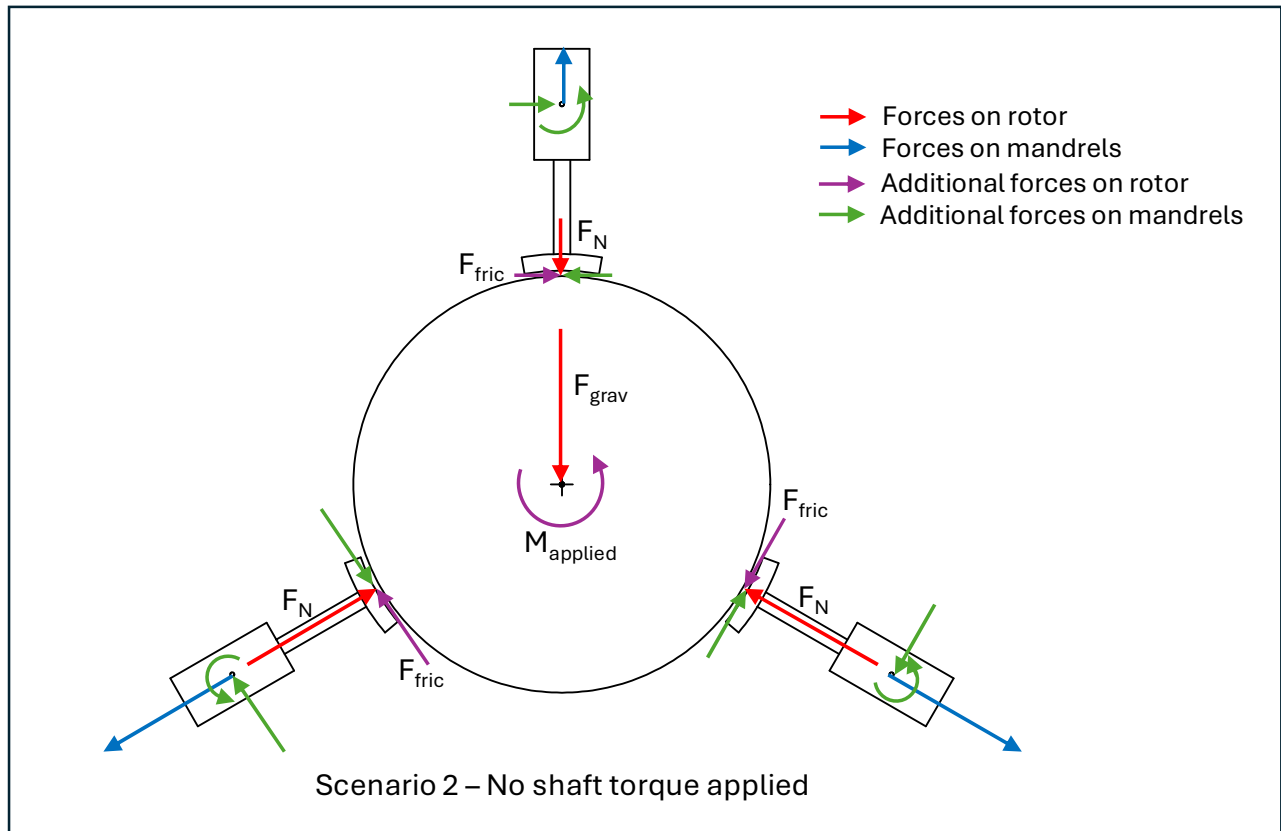
429. By comparison, free body diagrams are shown below for the scenario with three pressure mandrels.³⁰ Here, in the first diagram, no external torque is applied to the main shaft. Here the forces applied to the main shaft are depicted in red and the forces on the mandrels are depicted in blue. It can be appreciated that the mandrels only subjected to compressive forces, and no bending moments are present. In the case where an external torque is applied to the main shaft, the forces

³⁰ As with the two-mandrel free body diagrams, the gravity force may be reversed for a gearbox replacement, and the externally applied torque on the main shaft may be reversed for a different blade configuration.

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and moments acting on the main shaft are shown in purple and the forces and moments acting on the mandrels are shown in green. Here you can see that there are small bending moments acting on the mandrels, but they are smaller than the bending moments in Scenario 1 because gravity loads do not create bending moments, and the forces that react torque loads on the shaft are shared between three mandrels instead of only 2.





430. It can be seen from the above that the forces and bending moments acting on the mandrels are simplified when three or more mandrels are utilized. The specification of the parent applications to the '578 Patent confirm this by specifying that “the main shaft fixture comprises **at least three** radial displaceable pressure mandrels...” ’617 App. at [0009]; ’288 App. at [0008] (same); ’040 App. at 3:1-3 (same). The use of **only two** pressure mandrels is a more complicated design, as shown by the free-body diagrams above, that is not supported by the specification of the parent applications.

431. Because the full scope of Claims 1 and 3-17 is broad enough to include an apparatus with **two** pressure mandrels, but the applications to which they claim

priority exclusively disclose using **at least three** pressure mandrels, there is insufficient written description support for the scope of Claims 1 and 3-17 in the Parent Applications to which the '578 Patent claims priority. The scope of Claims 1 and 3-17 (two or more pressure mandrels) is broader than the disclosure in the Parent Applications (at least **three** pressure mandrels). Claims 1 and 3-17 therefore encompass subject matter beyond what was described in the Parent Applications to which the '578 Patent claims priority. There is no indication that the applicant was in possession of an inventive apparatus having only two pressure mandrels.

432. In view of my opinion that there is no written description support for Claims 1 and 3-17 in the Parent Applications to which the '578 Patent claims priority, it is my opinion that these claims are not entitled to a priority date before January 24, 2024 (the filing date of the '578 Patent).

433. The '518 Patent was published on August 13, 2019, more than a year before the effective filing date of the '578 Patent. The '518 Patent is therefore prior art under at least AIA 35 U.S.C. § 102(a)(1).

2. Claim 1

434. The specification of the '518 Patent is nearly identical to the specification of the '578 Patent (with the notable exception of the deletion discussed above). Further, much of the claim language of the Challenged Claims is pulled verbatim from the specification. In addition, the claims of the '518 Patent contain

many elements that are identical, or substantially identical, to the Challenged Claims. As such, the Challenged Claims are disclosed verbatim, or nearly verbatim, by the '518 Patent.

a. **1[Pre]: “Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine”**

435. I have been informed that this first element of Claim 1 may be considered a preamble and that preambles are not always limiting. For purposes of my analysis, I have been asked to assume that this element is limiting. The '518 Patent discloses this element.

436. The '518 Patent discloses that “[t]he present invention relates to a main shaft fixture for the fixing of a main shaft on a wind turbine during the execution of installation and repair work in heavy parts of a wind turbine....” '518 Patent at 1:7-10; *see id.* at Abstract (same), 4:29-52 (brief description of the drawings, which all relate to the main shaft fixture), Figs. 1-5; *see also id.* at Claim 1 (reciting a substantially identical limitation).

b. **1[a]: “where the fixture is divided up into a number of sections for mounting on stable structural parts in a nacelle of a wind turbine, including a bottom frame of the nacelle”**

437. The '518 Patent discloses this element.

438. The '518 Patent discloses that “[t]he present invention relates to a main shaft fixture, ...with the fixture being divided up into a number of sections for

installation on stable structural parts in a nacelle in a wind turbine, including the nacelle's bottom frame." '518 Patent at 1:7-13; *see id.* at Abstract ("...where the fixture is formed of several sections..."); *see also id.* at Claim 1 (reciting a substantially identical limitation).

c. **1[b]: "characterized in that the main shaft fixture comprises adjustable pressure mandrels with tap shoes"**

439. The '518 Patent discloses this element.

440. The '518 Patent discloses that "[t]he main shaft fixture has adjustable pressure mandrels with tap shoes...." '518 Patent at Abstract; *see id.* at 2:21-30 ("[T]he main shaft fixture comprises at least three radial displaceable pressure mandrels...."), 6:32-37 ("The inventor has recognised [sic] that the main shaft fixture 10 can assume other embodiments than disclosed in the preceding and shown in the figures, however such do not change the inventive aspect that is comprised of specifying a main shaft fixture 10 of the given type that comprises adjustable pressure mandrels 18 with tap shoes 20...."), Figs. 2, 4, 5 (showing items 18, 20); *see also id.* at Claim 1 (reciting a substantially identical limitation).

d. **1[c]: "and the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft"**

441. The '518 Patent discloses this element.

442. The '518 Patent discloses “pressure mandrels being displaceable between a passive, withdrawn lockable position where the tap shoes are configured to be located at a distance from the surface of the main shaft and an advanced lockable position where the tap shoes are configured to be engaged with the main shaft.” '518 Patent at 2:25-30; *see id.* at 2:64-3:14, 5:13-18; *see also id.* at Claim 1 (reciting a substantially identical limitation).

- e. **1[d]: “and in that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.”**

443. The '518 Patent discloses this element.

444. Element 1[d] does not limit the claimed mounting facilities to use with any particular type of crane (such as a lightweight crane or a self-hoisting crane). As such, mounting facilities for any type of crane meets this limitation.

445. The '518 Patent discloses that “[t]he main shaft fixture also has facilities for mounting of a lightweight crane and a self-hoisting crane with a ground-based winch....” '518 Patent at Abstract; *see id.* at 2:16-18 (“It is further the purpose of the invention to provide a main shaft fixture that in addition offers facilities for the mounting of a self-hoisting crane, with a ground-based winch.”), 2:43-63, 4:29-33 (“FIG. 1 [shows] a main shaft fixture according to the invention, with a lightweight crane and a self-hoisting crane mounted....”), 4:57-64 (“[T]he main shaft fixture 10 according to the invention is shown in the mounted state, bearing a

lightweight crane 12 and a self-hoisting crane 14.....”), 5:19-38 (“As it appears from FIG. 3, ...bracket facilities 23 are seen for a self-hoisting crane 14....”), 5:59-61 (“In FIG. 1, it is moreover shown how the main shaft fixture 10 comprises mounting facilities 40 for the lightweight crane 12.”).

3. **Claim 3: “Main shaft fixture, according to claim 1, characterized in, that the mounting facilities are adapted for anchoring a self-hoisting crane on/in a nacelle of a wind turbine and in that a winch of the self-hoisting crane is located on a ground surface near a foot of the wind turbine.”**

446. The main shaft fixture of Claim 1 is disclosed by the ’518 Patent. *See supra* (Ground 4) Section XII.D.2.

447. The additional elements of Claim 3 are disclosed by the ’518 Patent.

448. The ’518 patent discloses “[t]he main shaft fixture also has facilities for mounting of...a self-hoisting crane with a ground-based winch....” ’518 Patent at Abstract; *see id.* at 2:16-18 (“It is further the purpose of the invention to provide a main shaft fixture that in addition offers facilities for the mounting of a self-hoisting crane, with a ground-based winch.”), 2:43-63 (“[T]he main shaft fixture...may comprise mounting facilities for a self-hoisting crane whose winch is placed on the ground surface ground near the foot of the wind turbine.”), 4:57-64 (“[T]he main shaft fixture 10 according to the invention is shown in the mounted state, bearing a lightweight crane 12 and a self-hoisting crane 14 with a ground-based winch (not

shown).....”), 5:19-38 (“As it appears from FIG. 3, ...bracket facilities 23 are seen for a self-hoisting crane 14 with a ground-based winch (not shown).”).

4. **Claim 4: “Main shaft fixture, according to claim 1, characterized in, that the adjustable pressure mandrels is provided with actuators for displacing and retaining the tap shoes in the passive position and the active position, respectively, alternatively in a selectable position between the passive and the active position.”**

449. The main shaft fixture of Claim 1 is disclosed by the ’518 Patent. *See supra* (Ground 4) Section XII.D.2.

450. The additional elements of Claim 4 are disclosed by the ’518 Patent.

451. The ’518 Patent discloses that “[f]or the purpose of securing the rapid fixing of the main shaft using the main shaft fixture according to the invention, the pressure mandrels may be provided with actuators for displacing and retaining the tap shoes in the passive position and the active position, respectively, alternatively in a selectable position between the passive and the active position.” ’518 Patent at 2:64-3:5; *see id.* at Claim 4 (reciting a substantially identical limitation).

5. **Claim 5: “Main shaft fixture, according to claim 1, characterized in, that the adjustable pressure mandrels consists of threaded bolts whose opposing free ends facing the main shaft are furnished with tap shoes, and the threaded bolts cooperates with threaded holes in relevant sections of the main shaft fixture.”**

452. The main shaft fixture of Claim 1 is disclosed by the ’518 Patent. *See supra* (Ground 4) Section XII.D.2.

453. The additional elements of Claim 5 are disclosed by the '518 Patent.

454. The '518 Patent discloses that “the pressure mandrels may be comprised of threaded bolts whose free ends facing the main shaft are furnished with tap shoes, where the threaded bolts work together with threaded holes in relevant sections of the fixture.” '518 Patent at 3:6-11; *see id.* at 3:11-14 (“The pressure mandrels with the tap shoes are hereby displaced by manual turning of the threaded bolts between the passive position and the active position.”).

6. Claim 6: “Main shaft fixture, according to claim 1, characterized by a slideway lining being located between opposing sides of a surface of the main shaft and tap shoes.”

455. The main shaft fixture of Claim 1 is disclosed by the '518 Patent. *See supra* (Ground 4) Section XII.D.2.

456. The additional elements of Claim 6 are disclosed by the '518 Patent.

457. The '518 Patent discloses that “[t]he tap shoes on the main shaft fixture’s pressure mandrels may cooperate with the multi-part slide plate on the main shaft, with or without slideway linings on the opposing sides of the tap shoes facing the main shaft.” '518 Patent at 3:37-41; *see id.* at 5:59-61 (“As shown in FIG. 4, a slideway 42, 44 is located between the opposing sides of the tap shoes 20 facing the surface of the main shaft 4.”), Fig. 4.

7. Claim 7: “Main shaft fixture according to claim 6, characterized in, that the slideway lining is configured so that of [sic] opposing free ends of the tap shoes facing the main shaft are provided with a slide plate which in the

active position is engaged with the main shaft.”

458. The main shaft fixture of Claim 6 is disclosed by the '518 Patent. *See supra* (Ground 4) Sections XII.D.2, XII.D.6.

459. The additional elements of Claim 7 are disclosed by the '518 Patent.

460. The '518 Patent discloses that “[t]he slideway may be comprised of slide plates 42 that are fastened to the opposing free ends of the tap shoes 20 facing the main shaft 4, which in their active advanced position are engaged with the main shaft 4...” '518 Patent at 5:62-6:5; *see id.* at 3:24-27 (“In a first embodiment of the slide plates, this could comprise the free ends of tap shoes facing against the main shaft being furnished with slide plates, which in the active extended position are engaged with the main shaft.”), 5:59-61 (“As shown in FIG. 4, a slideway 42, 44 is located between the opposing sides of the tap shoes 20 facing the surface of the main shaft 4.”), Figs. 4; *see also id.* at Claims 5-6 (reciting substantially identical limitations).

8. Claim 8: “Main shaft fixture according to claim 7, characterized in that it comprises a multi-part slide plate cooperating with the main shaft for mounting on the main shaft, where the multi-part slide plate in its mounted position on the main shaft is cooperating with the tap shoes.”

461. The main shaft fixture of Claim 7 is disclosed by the '518 Patent. *See supra* (Ground 4) Sections XII.D.2, XII.D.6, XII.D.7.

462. The additional elements of Claim 8 are disclosed by the '518 Patent.

463. The '518 Patent discloses “the main shaft fixture may according to the invention comprise a multi-part slide plate working in conjunction with the main shaft to be mounted on the main shaft, where the multi-part slide plate in its mounted state on the main shaft cooperates with the tap shoes.” '518 Patent at 3:28-33; *see also id.* at 3:37-41 (“The tap shoes on the main shaft fixture’s pressure mandrels may cooperate with the multi-part slide plate on the main shaft, with or without slideway linings on the opposing sides of the tap shoes facing the main shaft.”), 5:62-6:2 (“The slideway...may comprise a multi-part slide plate 44 cooperative working with the main shaft 4, for mounting on the main shaft 4, said multi-part slide plate 44 in its mounted state on the main shaft 4 cooperates with the tap shoes 20.”), Fig. 4; *see also id.* at Claim 7 (reciting a substantially identical limitation).

9. **Claim 9: “Main shaft fixture according to claim 1, characterized in, that it comprises one of a multi-part needle bearing, roller bearing, ball bearing consisting of a multi-part inner ring fastened to the main shaft, and a therewith cooperating multi-part outer ring consisting of bowed subsegments corresponding to a number of tap shoes, mounted on opposing side of the tap shoes facing an inner ring, which in the active position of the adjustable pressure mandrels form an outer ring at a distance from an outer periphery of the multi-part inner ring, and where an appropriate number of needle rollers, rollers, or balls are arranged between the inner ring and the outer ring, and where means are present for retaining needles, rollers, or balls in position between the inner ring and outer ring.”**

464. The main shaft fixture of Claim 1 is disclosed by the '518 Patent. *See supra* (Ground 4) Section XII.D.2.

465. The additional elements of Claim 9 are disclosed by the '518 Patent.

466. The '518 Patent discloses:

In a further embodiment of the main shaft fixture as per the invention, it may comprise a multi-part needle bearing, roller bearing, ball bearing, consisting of a, multi-part inner ring, fastened on the main shaft, and a therewith cooperating multi-part outer ring consisting a number of bowed sub segments according to the number of tap shoes mounted on the opposing side of the tap shoes facing the multi-part inner ring, which in the advanced active position of the pressure mandrels form the outer ring at a distance from the external periphery of the multi-part inner ring, and where a suitable number of needle rollers, rollers or balls are placed between the inner ring and outer ring, and where means are present for retaining the needles, rollers, or balls in position between the inner ring and outer ring.

'518 Patent at 3:42-55; *see id.* at 4:46-52 (“FIG. 5 is a detailed perspective view or the main shaft fixture for a wind turbine, where the slide plates are replaced by a multi-part needle bearing/roller bearing/ball bearing formed of a multi-part inner ring fastened to the main shaft and a therewith cooperating multi-part outer ring consisting of bowed sub-segments of the number of tap shoes mounted on the opposing side of the tap shoes facing the inner ring.”), 6:6-20, Fig. 5; *see also id.* at Claim 1 (reciting a substantially identical limitation).

10. Claim 10: “Main shaft fixture, according to claim 1, characterised in, that it comprises a rotor lock for fixation of a rotor of the wind turbine.”

467. The main shaft fixture of Claim 1 is disclosed by the '518 Patent. *See supra* (Ground 4) Section XII.D.2.

468. The additional elements of Claim 10 are disclosed by the '518 Patent.

469. The '518 Patent discloses that “[w]ith the intent of being able to fix the rotor on the wind turbine after it has been braked to a stop, the main shaft fixture according to the invention, may comprise a rotor lock, for fixing the wind turbine rotor.” ’518 Patent at 3:59-62; *see id.* at 5:19-30 (describing how “a rotor lock is fastened in the form of a flange element 24”), Figs. 1, 3; *see also id.* at Claims 1-2 (reciting substantially identical limitations).

11. Claim 11: “Main shaft fixture, according to claim 10, characterised in, that the rotor lock consists of a flange element, whose bolt circle geometry corresponds to a bolt circle geometry on the rotor, the flange element being fastened to a first end of two first beam-shaped brackets extending parallel with, and on each side of the main shaft, the beam shaped brackets belonging to the main shaft fixture, and where a second end of the beam-shaped brackets are pivotally mounted with horizontally oriented bolt connections, on other beam-shaped brackets belonging to the main shaft fixture, which are adapted to be anchored on the bottom frame of the nacelle.”

470. The main shaft fixture of Claim 10 is disclosed by the '518 Patent. *See supra* (Ground 4) Sections XII.D.2, XII.D.10.

471. The additional elements of Claim 11 are disclosed by the '518 Patent.

472. The '518 Patent discloses that “[i]n a preferred embodiment of the rotor lock, it is comprised of a flange, whose bolt circle geometry corresponds to a bolt circle geometry on the rotor, said flange element being fastened at the ends to the first end of two first beam-shaped brackets extending parallel with, and on each side

of the main shaft, said beam shaped brackets belonging to the main shaft fixture, and where the other end of the brackets are pivotally mounted with horizontally oriented bolt connections, on other brackets belonging to the main shaft fixture, which are anchored on the bottom frame of the nacelle.” ’518 Patent at 3:63-4:6; *see id.* at 5:19-30 (“As it appears from FIG. 3, the main shaft fixture 10 comprises two parallel passing first beams 22, one on each side of the main shaft 4. In first ends of each first beam 22 nearest to the rotor 8, a rotor lock is fastened in the form of a flange element 24, the hole circle geometry 26 of which is similar to the hole circle geometry 28 of the rotor 8 over part of the periphery of the rotor. For locking of the rotor 8, the holes 7 in the rotor 8 and the holes 9 in the flange element 24 are brought to overlap, and subsequently, bolts are inserted through the overlapping holes, which are tightened with nuts, after which the rotor 8 is fixed/locked by the flange element 24.”), Fig. 3; *see also id.* at Claim 2 (reciting a substantially identical limitation).

12. Claim 12: “Main shaft fixture, according to claim 11, characterised in, that at least one actuator is located nearest the rotor lock between the bottom frame of the nacelle and an adjacent side of the first beam-shaped brackets facing the bottom frame, the actuator is displaceable between a first passive outer position and an active outer position where the flange element is displaced vertically.”

473. The main shaft fixture of Claim 11 is disclosed by the ’518 Patent. *See supra* (Ground 4) Sections XII.D.11, XII.D.10, XII.D.2.

474. The additional elements of Claim 12 are disclosed by the ’518 Patent.

475. The '518 Patent discloses that “[w]ith the intent of being able to perform replacement of the shafts main bearing, without being forced to dismount the main shaft, the main shaft fixture may furthermore comprise at least a second actuator, between the nacelle's bottom frame and the opposing side of the first beam-shaped brackets facing such and the nearest rotor lock, where the other actuator is movable between a first passive outer position and an active outer position whereby the flange element is moved vertically.” ’518 Patent at 4:11-19; *see id.* at 4:39-42 (“FIG. 3 is a more detailed perspective view from another angle of what is shown in FIG. 1, presenting the actuators for raising the main shaft, where the main shaft is made transparent....”), 5:39-49 (“As it appears in FIGS. 1 & 3, an actuator 36 is located between the bottom frame 2 and the parallel passing first beams 22. Activation of the actuator 36 will result in a change of the distance between the bottom frame 2 and the first beams 22, in which the flange element 24 is suspended, which will cause the flange element 24 and the rotor 8 and thereby the main shaft 4 to be raised, which will result in the possibility to replace the main shaft's bearing 38 without the necessity of hoisting the main shaft 4 down to the ground, which is quite time-saving when the main shaft bearing 38 has to be repaired or replaced.”), Figs. 1, 3; *see also id.* at Claim 8 (reciting a substantially identical limitation).

- 13. Claim 13: “Assembly for installing and repairing heavy parts of a wind turbine arranged in a nacelle of a wind turbine, the assembly comprising a main shaft fixture according to claim 1, characterized in that a crane is**

**mounted to the main shaft fixture via the mounting facilities
of the main shaft fixture.**

476. The main shaft fixture of Claim 1 is disclosed by the '518 Patent. *See supra* (Ground 4) Section XII.D.2.

477. The additional elements of Claim 13 are disclosed by the '518 Patent.

478. The '518 Patent discloses that “Fig. 1 is a perspective view of parts of a wind turbine nacelle, presenting the nacelle bottom frame, the wind turbine main shaft, and a main shaft fixture according to the invention, with a lightweight crane and a self-hoisting crane **mounted**.” '518 Patent at 29-33; *see id.* at 4:57-63 (“FIG. 1 shows a bottom frame 2 in a nacelle (not shown) on a wind turbine (not shown), where the main shaft 4 of the turbine, with a gear box 6 and a rotor 8, and where the main shaft fixture 10 according to the invention is shown in the **mounted** state, bearing a lightweight crane 12 and a self-hoisting crane 14 with a ground-based winch (not shown), respectively.”), Figs. 1-3.

**14. Claim 14: “Main shaft fixture, according to claim 1,
characterised in that the mounting facilities are adapted for
anchoring a lightweight crane on/in a nacelle of a wind
turbine.”**

479. The main shaft fixture of Claim 1 is disclosed by the '518 Patent. *See supra* (Ground 4) Sections XII.D.2.

480. The additional elements of Claim 14 are disclosed by the '518 Patent.

481. The '518 Patent discloses that “[t]he main shaft fixture also has facilities for mounting of a lightweight crane....” ’518 Patent at Abstract; *see id.* at 4:29-33 (“FIG. 1 [shows] a main shaft fixture according to the invention, with a lightweight crane...mounted....”), 4:57-64 (“[T]he main shaft fixture 10 according to the invention is shown in the mounted state, bearing a lightweight crane 12....”), 5:59-61 (“In FIG. 1, it is moreover shown how the main shaft fixture 10 comprises mounting facilities 40 for the lightweight crane 12.”).

15. Claim 15:

- a. **15[Pre]: “Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine”**

482. This element of Claim 15 is identical to element 1[Pre] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.a.

- b. **15[a]: “where the main shaft fixture is divided up into a number of sections for mounting on stable structural parts in a nacelle of a wind turbine, including a bottom frame of the nacelle”**

483. This element of Claim 15 is identical to element 1[a] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.b.

- c. **15[b]: “characterised in that the main shaft fixture comprises adjustable pressure mandrels with tap shoes, and”**

484. This element of Claim 15 is identical to element 1[b] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.c.

- d. **15[c]: “the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft”**

485. This element of Claim 15 is identical to element 1[c] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.d.

- e. **15[d]: “the adjustable pressure mandrels consisting of threaded bolts whose opposing free ends facing the main shaft are furnished with tap shoes, and the threaded bolts cooperates with threaded holes in relevant sections of the main shaft fixture”**

486. This element of Claim 15 is substantively identical to Claim 5 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.5.

- f. **15[e]: “and in that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine”**

487. This element of Claim 15 is identical to element 1[d] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.e.

16. Claim 16:

- a. **16[Pre]: “Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine,”**

488. This element of Claim 16 is identical to element 1[Pre] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.a.

- b. **16[a]: “where the main shaft fixture is divided up into a number of sections for mounting on stable structural parts in a nacelle of a wind turbine, including a bottom frame of the nacelle”**

489. This element of Claim 16 is identical to element 1[a] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.b.

- c. **16[b]: “characterized in[] that the main shaft fixture comprises adjustable pressure mandrels with tap shoes, and”**

490. This element of Claim 16 is substantively identical to element 1[b] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.c.

- d. **16[c]: “the adjustable pressure mandrels being displaceable between a passive position where the tap shoes are configured to be located at a distance from a surface of the main shaft and an active position where the tap shoes are configured to be engaged with the main shaft and”**

491. This element of Claim 16 is identical to element 1[c] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.d.

- e. **16[d]: “in that the main shaft fixture further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine, and”**

492. This element of Claim 16 is identical to element 1[d] of Claim 1 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.2.e.

- f. **16[e]: “further comprising a rotor lock for fixation of a rotor of the wind turbine,”**

493. This element of Claim 16 is identical to Claim 10 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.10.

- g. **16[f]: “wherein the rotor lock consists of a flange element, whose bolt circle geometry corresponds to a bolt circle geometry on the rotor, the flange element being fastened to a first end of two first beam-shaped brackets extending parallel with, and on each side of the main shaft, the two first beam shaped brackets belonging to the main shaft fixture, and where a second end of the two first beam shaped brackets are pivotally mounted with horizontally oriented bolt connections, on other brackets belonging to the main shaft fixture, which are adapted to be anchored on the bottom frame of the nacelle”**

494. This element of Claim 16 is substantively identical to Claim 11 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.11.

17. **Claim 17: “Main shaft fixture, according to claim 16, wherein at least one actuator is located nearest the rotor lock between the bottom frame of the nacelle and an adjacent side of the first beam shaped brackets facing the bottom frame, the actuator is displaceable between a first passive outer position and an active outer position where the flange element is displaced vertically.”**

495. This element of Claim 17 is identical to Claim 12 and my analysis for this Ground 4 is the same. *See supra* (Ground 4) Section XII.D.12.

XIII. SECONDARY CONSIDERATIONS

496. I am not aware of any secondary considerations of non-obviousness for the Challenged Claims of the '578 Patent. However, if Patent Owner raises any

Declaration of John Bosche in Support of Petition for
Inter Partes Review of U.S. Pat. No. 12,104,578
evidence of secondary considerations or objective indicia in its briefing or in any
expert declaration, I reserve the right to respond to those considerations.

XIV. CONCLUSION

497. For the foregoing reasons, it is my opinion that Claims 1 and 3-17 of
the '578 Patent were anticipated and Claims 1-17 of the '578 Patent would have been
obvious to a POSITA at the time of the alleged invention.

Executed on November 4, 2025 in Bellingham, WA.



John Bosche

APPENDIX A
(Corrected Preliminary Amendment to Claim 1)

1. (Currently Amended) ~~A self hoisting crane comprising: mounting facilities for mounting to a lightweight crane, a winch located on a ground surface near a foot of the wind turbine, and a m~~ Main shaft fixture for fixation of a main shaft on a wind turbine during execution of installation and repair work on heavy parts of a wind turbine, where the fixture being is divided up into a number of sections for mounting on stable structural parts in a nacelle of a wind turbine nacelle, including a the bottom frame of the nacelle, characterised in, that wherein the main shaft fixture comprises at least three independently, radially displaceable adjustable pressure mandrels for fixing of cylinder shaped shafts with different diameters and for the fixing of shafts with conical shapes, the with tap shoes, and said pressure mandrels being substantially symmetrical located around a center axis, first ends of said pressure mandrels, in use, facing the main shaft and being furnished with a tap shoe, wherein said pressure mandrels are displaceable between a passive, withdrawn lockable, position where the tap shoes are configured to be located at a distance from the surface of the main shaft and an active advanced lockable position where the tap shoes are configured to be engaged with the main shaft, and in use, that said tap shoes enabling the main shaft to be fixed in position by the main shaft fixture while being permitted to rotate. further comprises mounting facilities adapted for anchoring a crane on/in a nacelle of a wind turbine.