

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AFFORDABLE WIRE MANAGEMENT, LLC,
Petitioner,

v.

CAMBRIA COUNTY ASSOCIATION FOR THE BLIND AND
HANDICAPPED, INC.,
Patent Owner.

IPR2024-00182
Patent 11,349,291 B2

DECLARATION OF OMID BEIK, Ph.D.

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I. Introduction

1. I, Omid Beik, Ph.D., have been retained by Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C. on behalf of Petitioner Affordable Wire Management, LLC (“AWM” or “Petitioner”) as an independent expert to opine on the patentability of U.S. Patent No. 11,349,291 (the “’291 Patent”).

2. I understand that Petitioners seek a determination that claims 1-23 of the ’291 Patent are unpatentable, and this Declaration is being filed in support of the invalidation of those claims.

3. If called to testify as an expert witness, I expect to provide testimony regarding, among other things, the level of skill, education and experience of a person skilled in the field of solar electric power systems technologies during the relevant time for this case.

4. I reserve the right to supplement this Declaration if additional information that affects my opinions becomes available. It may be necessary for me to revise or supplement this Declaration, or submit a supplemental or responsive Declaration, based on any response by Patent Owner.

5. I receive \$225 per hour for my services. My compensation is not contingent upon the particular opinions that I provide, and I have no financial interest in the outcome of this matter. I have no ownership or beneficial interest in any of the parties to this case.

II. Experience and Qualifications

6. I am currently an Assistant Professor (tenure-track) in the Department of Electrical Engineering at Colorado School of Mines (“CSM”), Golden, CO, a position that I have held since August 2023. I have a research laboratory, ePower Hubs (<https://www.epowerhubs.com/>), where my team of graduate students and I work on different aspects of electrical power grids, renewable energy systems, and electrification.

7. Prior to joining CSM, I started my academic in the Department of Electrical and Computer Engineering at North Dakota State University (NDSU), Fargo, ND, where I was a tenure-track Assistant Professor from October, 2021 to July, 2023.

8. During my academic career, my research has been supported by: (i) a startup grant from CSM, (ii) a startup grant from North Dakota State University (“NDSU”), (iii) research grants where I have been principal investigator on three National Aeronautics and Space Administration (“NASA”) research grants under Established Program to Stimulate Competitive Research (“EPSCoR”), (iv) an NDSU foundation grant, (v) and an industry collaborative project that I secured with CorVent Inc., Fargo, ND.

9. Prior to joining academia, I spent a number of years in the industry in Canada. From 2020 to 2021, I was a Senior Manager with Forte (Everwin) Mobility

Co. Ltd. in Aurora, Ontario, Canada, where I led the research and development of an electric powertrain for an electric van.

10. In 2019, I founded Enercs Inc., an early-stage technology startup in Toronto, Canada that specialized in research and development of state-of-the-art technologies in power electronics, electric machines, and drives for applications in renewable energy systems and electrification.

11. From 2018 to 2019, I was a Lead R&D Engineer with Mirus International Inc. in Brampton, Ontario, Canada, where I developed an active power filter for reducing harmonics in the distribution grid. From 2017 to 2018, I was a Senior Engineer with Magna Powertrain Inc. in Concord, Ontario, Canada, where I designed electrified products for automotive applications.

12. Prior to my industry experience, from 2016 to 2017, I was Postdoctoral Research Fellow at McMaster University in Hamilton, Ontario, Canada, where I worked on a collaborative project with Safran Electronics & Defense on developing a mini digital core module (“MDCM”) for aerospace applications.

13. I received my Ph.D. degree in Electrical and Computer Engineering from McMaster University in 2016. My Ph.D. focused on research and development of renewable energy systems and their integration to the electric power grid. From 2011 to 2012, I was also a Postgraduate Researcher at the University of Manchester,

in the UK, where I worked on research and development of hybrid and electric vehicles powertrains.

14. In 2009, I received a Master of Science from Department of Electrical Engineering, Shahid Beheshti University, Abbaspour School of Engineering, in Tehran, Iran. My master thesis was on stability analyses of electric power grids. In 2007, I received a Bachelor of Science from Department of Electrical and Electronics Engineering, Yazd University, in Yazd, Iran. My undergraduate research project was on electric drives for AC permanent magnet motors.

15. I authored and co-authored several books which are listed below:

- *DC Wind Generation Systems, Design, Analysis, and Multiphase Turbine Technology*, Springer, 2020.
- *Wind and Solar Power Systems: Design, Analysis, and Operation*, CRC Press, 2021.
- *Multiphase Hybrid Electric Machines: Applications for Electrified Powertrains*, Springer, 2021.
- *Spacecraft Power Systems*, CRC Press, 2024.

16. I have authored and co-authored a portfolio of peer-reviewed journal & conference papers. For a complete list my publications see my google scholar page (<https://scholar.google.com/citations?user=xcPNRoQAAAAJ&hl=en>).

17. I am Senior Member of Institute of Electrical and Electronics Engineers (“IEEE”), and have served as an Editor for IEEE Transactions on Energy Conversion and IEEE Power Engineering Letters, and Associate Editor for IEEE Transactions on Transportation Electrification and IEEE Electrification eNewsletter. I have also

served in various roles in the organizing committee of IEEE/International conferences.

18. A copy of my curriculum vitae is provided as **Appendix A**.

III. Materials Considered

19. My opinions are based on my education, training, background and experience, the documents I reviewed, and information available to me to date. I have reviewed and considered the documents and materials cited in this declaration. To the extent I am provided with additional documents or information in this proceeding, I reserve the right to modify or expand upon my opinions based on such new information, and in response to any additional reports and testimony.

IV. Legal Standard

20. In preparing this declaration, certain patent law concepts have been explained to me, including the legal standard for interpreting claims, as well as those for assessing written description, enablement, and obviousness.

21. I have been informed by counsel that the Patent Trial and Appeal Board (“PTAB”) applies the same claim construction standard used in district courts, where the claims are given their ordinary meaning as understood by one skilled in the art at the time of effective filing date, informed by the claim language itself, the specification, and the prosecution history. I also understand that “extrinsic evidence”—i.e., evidence other than the patent and prosecution history—can be

relevant in determining how a skilled artisan would understand terms of art used in the claims. I have been informed, however, that extrinsic evidence may not be used to contradict the meaning of the claims as described in the intrinsic evidence—i.e., evidence in the claim language itself, the specification, and the prosecution history.

22. I have been informed by counsel that a patent specification must enable a person of ordinary skill in the art to make and use the full scope of the claimed invention without undue experimentation as of its effective filing date.

23. I have been informed by counsel that, in addition to being required to be enabled, a claim in a granted patent must also be sufficiently supported by the disclosure in the patent's specification, read in the context of what one of skill in the art would have known at the time of the effective filing date. I understand that the basic inquiry for written description is whether the specification provides sufficient information for a skilled artisan to recognize that the named inventors possessed the full scope of the claimed invention.

24. I have further been informed by counsel that a claim is obvious if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art ("POSITA"). I have been informed that whether the differences between the claimed invention and the prior art are obvious depends on factors including the scope and content of the

prior art, the level of ordinary skill in the art, the differences between the claimed invention and the prior art, and secondary considerations of nonobviousness.

25. I also understand that whether a patent claim is obvious is determined from the perspective of a POSITA. I further understand that a claimed invention is obvious if a POSITA, before the effective filing date, would have been motivated to select, combine, or modify the relevant prior art elements during the normal course of research and development to yield the claimed invention with a reasonable expectation of success. I was also informed that when a claim recites a range, if prior art discloses a portion of the claimed range, the entire claimed range is obvious.

V. Summary of My Opinions

26. Claims 1-23 of the '291 Patent recite cable hangers supporting a plurality of conductive cables from a messenger wire.

27. In my opinion, the additional elements recited by the challenged dependent claims of the '291 Patent do not impart any patentability to the obvious of independent claims of the '291 Patent.

VI. State of the Art

A. Cable Hangers and Messenger Wires

28. Arial cable support systems, in both utility and solar electrical distribution systems, typically comprise (1) utility poles (or piles) comprised of metal, wood, concrete or composite materials, (2) a tension member running

between the poles or between poles and the ground or other electrical equipment (e.g., a messenger wire, a catenary cable, a cable tray, or a beam), and (3) mounting structures, support systems, and cable hangers (e.g., rings or saddles) spaced at regular intervals for supporting wires and cables. To avoid subjecting the current-carrying cables to the tensile force of gravity, aerial cable support systems require supporting the current-carrying cables at regularly spaced intervals between the poles.

29. Current-carrying cables will deflect under load when running between two poles unless they are supported by hangers. The maximum amount of deflection occurs in the middle of the cable and can be calculated based on (i) the length of the cable, (ii) the load that the hanger is supporting, (iii) the strength of cable material including the cable core (conductive material) and insulation (measured as elastic modulus), and (iv) the momentum of inertia. The amount of deflection increases as the length of the unsupported cable or its load increases. For a current carrying cable, higher currents require a cable with larger conductor diameter that makes the cable generally heavier, which in turn increases the load that must be supported. Absent a hanger, the forces in the current carrying cable will cause it to deflect, which over time may weaken both the cable conductor and its insulation. In turn this increases the likelihood of faults and short circuits as the cables come in contact with the ground or other conductive equipment. It may also cause injury or death if a person

comes in contact with it. Due to deflection, the current-carrying cables without a mounting mechanism to the poles or hangers are not able to support their own weight between two sufficiently spaced poles.

2.5 Step 5: Conduct Simplified Hand Calculation

The maximum vertical sagging displacement and the greatest bending stress at middle of span can be estimated based on following simplified formula.

Assumption:

- (1) The material is linear elastic
- (2) The side rail is prismatic, which means that cross-section remains constant throughout its length.

Maximum vertical deflection for simple span in Figure 11 is

$$\delta = \left| \frac{-wx(L^3 - 2Lx^2 + x^3)}{24EI} \right| \quad (6)$$

$$\text{With } \delta_{\max} = \frac{5wL^4}{384EI} \quad \text{at } x = L/2 \quad (7)$$

where E is Elastic modulus (N/mm²), I is Moment of Inertia of side rail (mm⁴), L is Support span (mm), x is Distance from pin support, w is Load per unit length (N/mm), and $\delta_{\max}$ is Maximum deflection (mm).

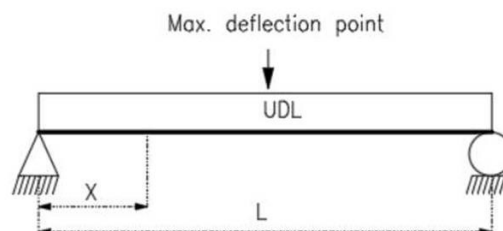


Figure 11. Simple beam with UDL

When cable ladders are installed across several supports with UDL as Figure 12, the maximum sagging displacement is

$$\delta_{\max} = \frac{0.0031 \times w \times L^4}{E \times I} \quad \text{at mid of intermediate span (8)}$$

where E is Modulus of elasticity (N/mm²), I is Moment of Inertia of side rail (mm⁴), w is Load per unit length (N/mm), L is Support span (mm), $\delta_{\max}$ is Maximum deflection (mm), and E and I are constant.

The Figure 14 shows the largest vertical deflection (vertical sagging of side rail) which is measured at mid-span. It significantly increases as span increases.

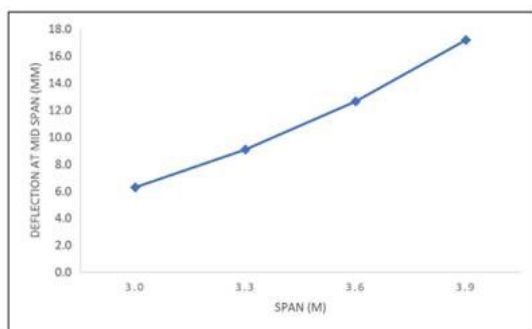


Figure 14. Maximum vertical deflection for simple span

EX1018, 7-9.

30. Standardized safety codes provide for suspending current-carrying cables using cable hangers hung from a messenger wire do not distinguish whether the installation is for solar or any other electrical power application. For example, the National Electrical Code (“NEC”), which is the main authority in providing standards for the electrical systems in the U.S. and is sponsored by the National Fire Protection Association, applies to electrical systems for residences, commercial and industrial facilities. *See* EX1009. Long before the time of the invention, the 2008 NEC provided guidance for messenger-supported wiring that used rings, saddles, or field-installed lashing material for conductor support. *Id.*, 241 (“An exposed wiring support system using a messenger wire to support insulated conductors by any one of the following: (1) A messenger with rings and saddles for conductor support [or] (2) A messenger with a field-installed lashing material for conductor support.”).

31. However, the idea goes back much further. For decades, cable hangers and messenger wires have been used to support various types of current-carrying cables and data cables in many industries and applications, including solar photovoltaic (“PV”) power systems. *See, e.g.*, EX1001, 1:17-42. A few examples include a U.S. Army technical manual which broadly explained in 1996 that “all overhead cables consist of a messenger, which provides support, and one or more conductors attached to it by rings, wrappings, lashings, or insulated spaces.” EX1010, 49. Additionally, a report jointly issued in 1984 by the Department of

Energy, NASA’s Jet Propulsion Laboratory, and Underwriters’ Laboratories explained that “a messenger with rings and saddles for conductor support” is a “practical PV application ... for terrestrial arrays located away from the building.” EX1007, 39. Similarly, in 2012, SnakeTray released a “cable tray system” that comprised a plurality of spaced apart hangers designed to be suspended from a messenger wire for use in solar installations. EX1008.

B. Separation of AC, DC, and Data Carrying Wires

32. Prior to 2014, it was well-known in all electrical fields, including solar, that bundling current-carrying and data cables together could cause problems. IEEE Standard 142 explains that current-carrying cables create magnetic fields. EX1019, 87-104 (Section 2.2). When current-carrying cables are placed adjacently, their magnetic fields must not cross-link with one another because this will cause circulating currents between the two current-carrying cables. The need for spacing between cables is also stated in the National Safety Code, where Rule 235G specifies that vertical spacing between conductive cables shall not be less than 4 to 12 inches, depending upon the span lengths. EX1020, 1. While cables were permitted to be adjacent to and contacting one another in a cable support systems (e.g., EX1001, 1:32-41, 2:3-6), it was best practice to avoid doing so. According to the ’291 Patent, the 2014 NEC—which went into effect January 1, 2014—required AC and DC cables to be separated in a hanging or support system. *Id.* The NEC requirement is

for the magnetic fields not to cross, and applies to any cables that carry current. This is not specific to any industry, but rather it is a function of current magnitude, materials, the physical properties of the cables, and the distance between them.

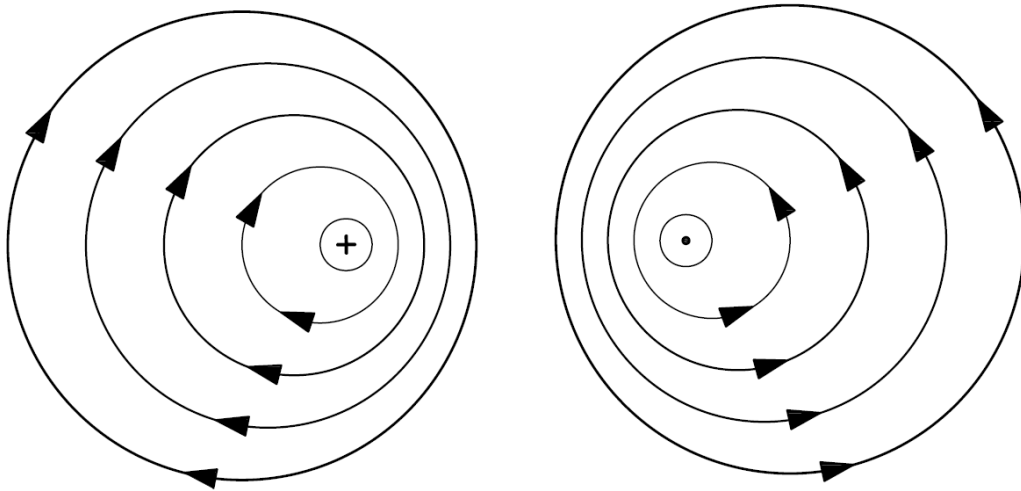


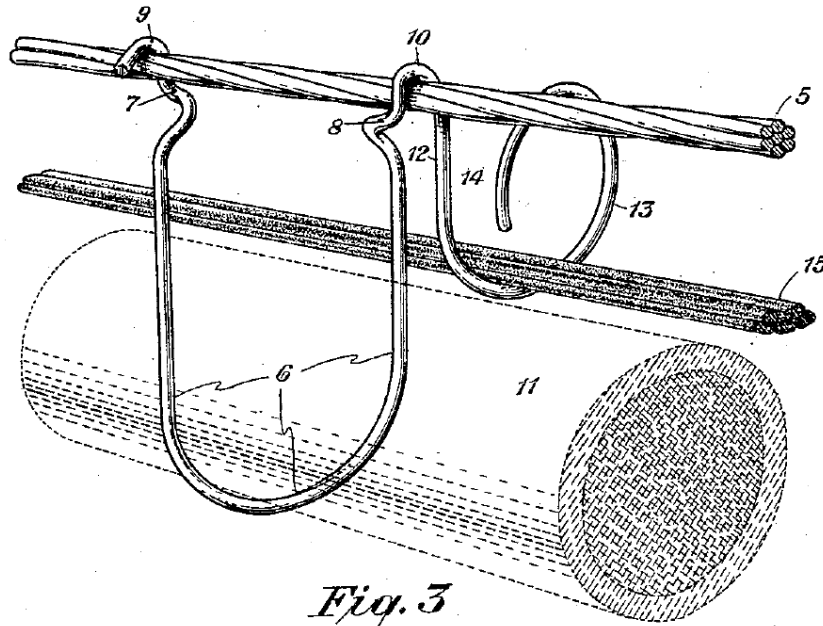
Figure 2-3—Magnetic field of wire as grounding conductor

EX1019, 91.

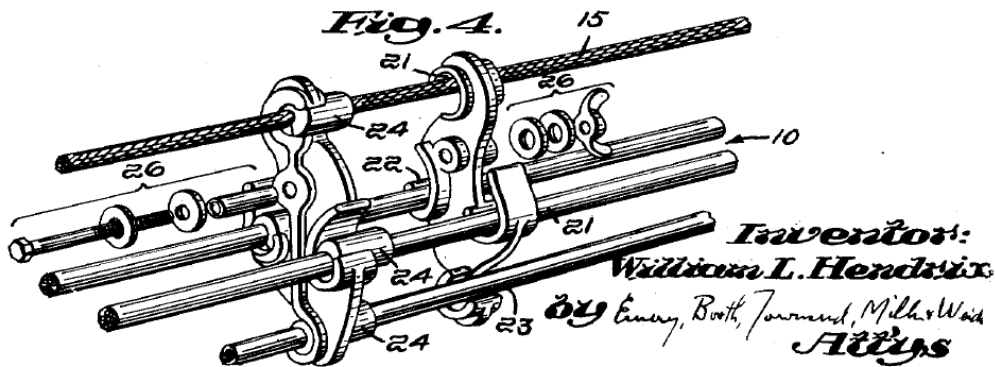
33. Additionally, although initially bundling cables with zip-ties, cable-ties, or other lashings was convenient, problems with these solutions were discovered. These approaches provide temporary solutions, but cannot be used permanently in power systems for several reasons: First, wire ties will rub against the insulation of a cable, causing wear and tear on both the insulation and wire tie itself, and thus should be replaced or inspected frequently. Second, plastic-based zip-ties/cable-ties will melt at high temperatures. This could be due to a fire, or a short circuit/fault where large amount of current may damage the cable insulation and

melt/damage the zip-tie. Third, large bundles of current-carrying cables, if not sufficiently supported, will deflect under load, and zip-ties/cable ties, even metal-based ones, cannot support a high load. Further, standard IEC 62275 specifies performance rating categories for cable ties which include, Mechanical, Thermal, Environmental, and Fire Effects. EX1021. For example, a 2013 article in SolarPro explains that wire ties “are not a permanent answer and require regular inspection and replacement” and therefore “should be avoided.” EX1011, 9. Therefore, there was a need for a more permanent and robust hanger solution in the solar industry.

34. Further, because the benefits of separating wires in electrical systems were well-known long before the '291 Patent, a variety of cable hanger designs for that purpose existed long before the time of the invention. For example, in 1932, U.S. Patent No. 1,841,479 issued to inventor George J. Jessen which disclosed a cable hanger containing two separated throughways to separately suspend two cables or conductors from a single messenger wire. EX1012, Fig. 3.

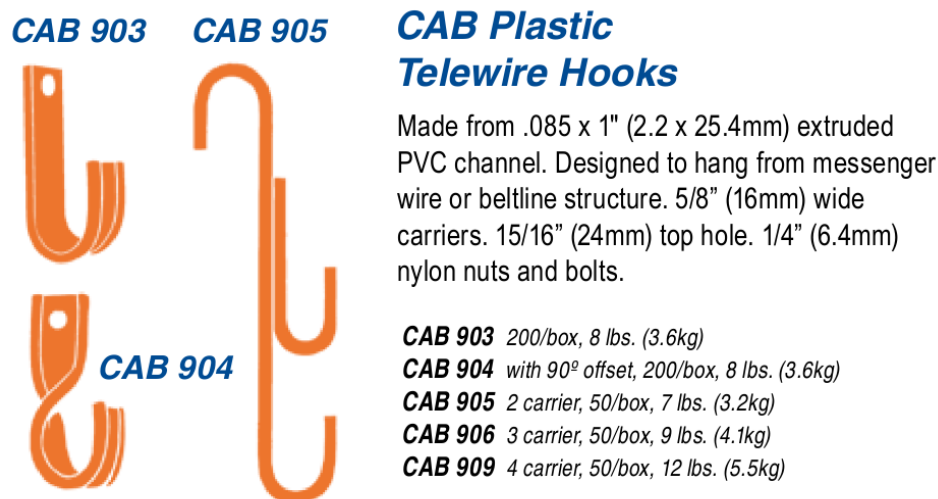


35. Similarly, in 1958, U.S. Patent No. 2,820,083 issued to inventor William L. Hendix—who founded Hendix Wire & Cable Inc., which is now one of the largest electrical system suppliers in the United States—disclosed a “hanger-spacer clamp” designed to support conductors from a messenger wire and without the use of shielding by spacing apart the conductors on the hanger. EX1013, 1:25-28, 1:70-2:9.



36. A cable hanger made by Hendrix, substantively similar to the one described in its original 1950's patent, was still being used in all electrical applications including solar at the time of the invention. EX1014, 1 (describing the Hendrix Spacer-Cable system being used with power from “nuclear, coal, hydro, solar, and wind power”).

37. Thus, the use of cable hangers in all aspects of the electrical power industries has been widespread over the last century. It is therefore unsurprising that, as early as in 2010, Patent Owner too was supplying cable hangers designed to support multiple spaced-apart conductors from a messenger wire:



EX1006, 8.

VII. The '291 Patent

38. I understand that the '291 Patent was filed as U.S. Patent Application No. 17/349,447 (the “'447 application”) on June 16, 2021, and claims priority to

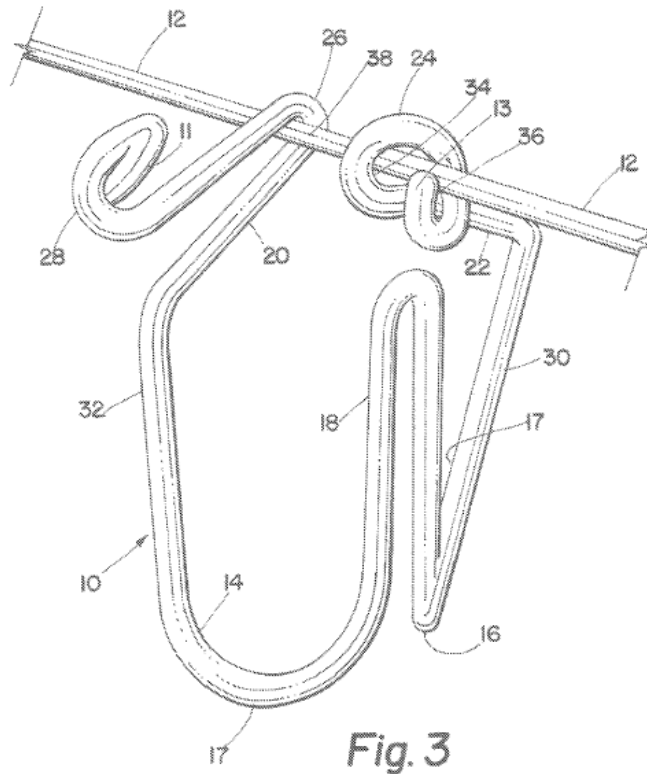
several earlier-filed applications. I further understand that the earliest-filed of those applications is No. 14/556,117, filed on November 29, 2014, now U.S. Pat. No. 9,722,405. Accordingly, I understand the priority date for the '291 Patent is no earlier than November 29, 2014.

39. I understand that the '291 Patent discloses “[a] cable hanger for the solar, mining, and electrical industry for use in supporting a plurality of conductive cables from a messenger wire.” EX1001, Abstract. The '291 Patent is directed to “a locking cable hanger and multiple cable carriers or saddles on one hanger” which can be used in “the solar, mining, and electrical industries.” EX1001, 1:18-19, 2:19-20. As to these industries, the '291 Patent explains that “there is a need for electrical cables to extend from a power or signal source to a location of application. *Id.*, 1:20-22.

40. As to locking, the '291 Patent describes a cable hanger that is attachable to a messenger wire with “two loops, one of which wraps around the messenger wire to effectively lock it in place and the other an open loop which simple latches onto the messenger wire.” *Id.*, 2:33-37. As to multiple cable carriers or saddles, the '291 Patent explains that the “locking hanger and saddle system can have one to five individual separate saddles or cable supports arranged in either a vertical or horizontal configuration.” *Id.*, 2:43-45.

41. According to the '291 Patent, in solar plants the DC wires, AC wires, and category five data cables are routed in parallel, often immediately adjacent to or even touching one another. *Id.*, 1:25-45. However, the '291 Patent explains that on January 1, 2014, a new version of the NEC went into effect that required all AC and DC wiring to be separated in a hanging cable system, including “cable trays, hangers, and all other types of cable support systems.” *Id.*, 2:3-6, 2:30-31. With this change, there was a need for hangers that have the required spacing and support. *Id.*, 2:6-13, 2:28-32.

42. To meet the NEC’s requirements, the '291 Patent discloses that “the spacing distance between the saddles can vary to any size to accommodate any size cable or cable bundle.” *Id.*, 3:53-56. As shown below in Figure 1 of the '291 Patent, “hanger 10 according to the present invention” includes “cable carrier formations 16, 17 with a cable divider 18 separating cable carrier formations 16 and 17.” *Id.*, 6:18-25. “What is important is that the hanger 10 provides a sufficient separation between both cable carrier formations 16, 17 and a further sufficient separation between the two carriers formations 16, 17, and the data carrier loop 28.” *Id.*, 7:14-17.



Id., Fig. 3.

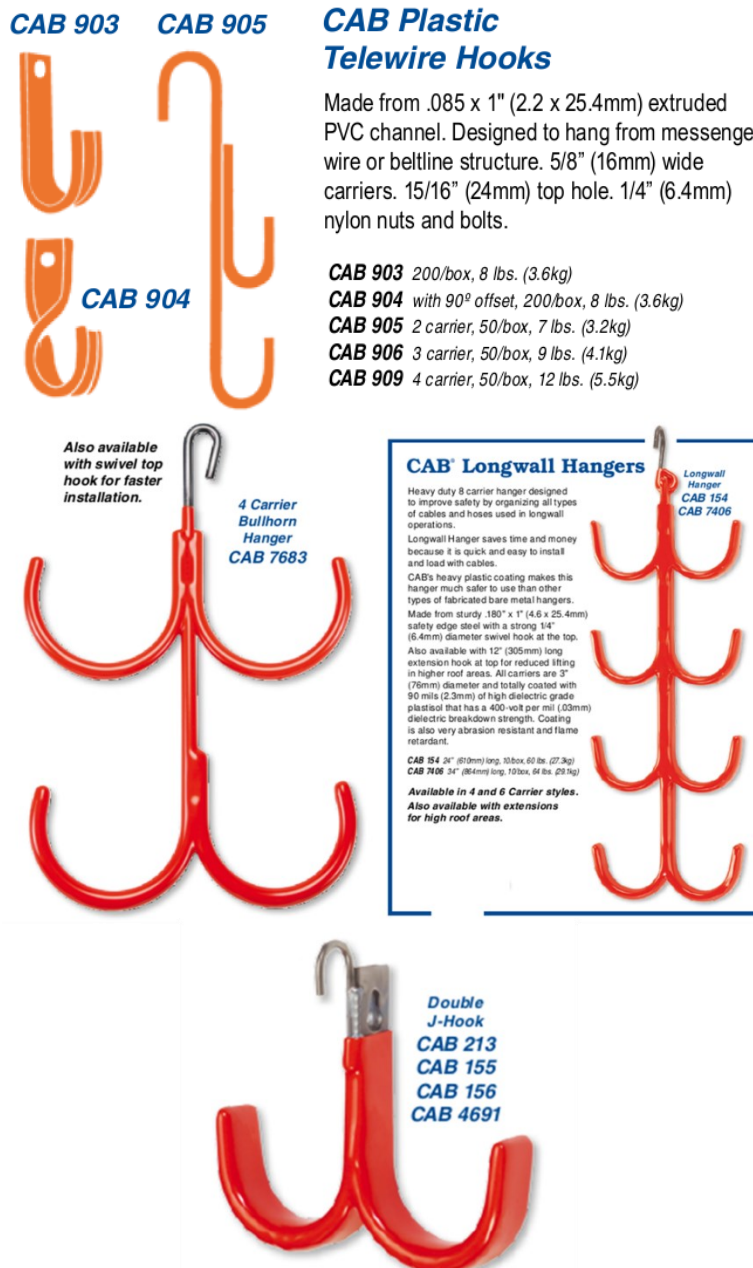
VIII. Prior Art

1. CAB Hooks, Hangers & Mine Safety Products Catalog

43. I understand that the “CAB Hooks, Hangers & Mine Safety Products” catalog (“*CAB Catalog*”) bears a copyright date of 2010, is identified as “ver2010” and was publicly available on CAB’s website at least as early as August 11, 2011. EX1006, 24. I understand that the *CAB Catalog* is prior art to the ’291 Patent.

44. The *CAB Catalog* shows and describes Patent Owner’s product offerings from before the time of the alleged ’291 Patent invention. According to the *CAB Catalog*, its products are “safely suspend *all types of electrical cables.*” *Id.*, 3.

The *CAB Catalog* discloses a wide variety of hangers for supporting “electrical cables” from messenger wire, plates, or other structures. *Id.*, 2, 8-9. The *CAB Catalog* also discloses cable hangers having a plurality (*i.e.*, more than one) of cable carrying surfaces:

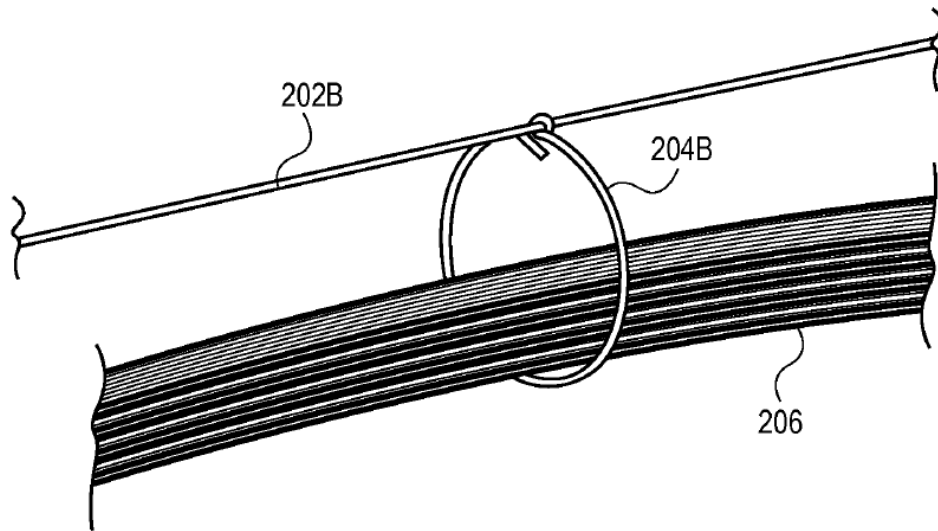


Id., 8-11. Such “multi carrier hooks” are designed to organize “sensor, communication, control and electrical wiring [and is] useful ... when running multiple cables.” *Id.*, 7.

2. *Almy*

45. I understand that “Wire-Based Hanging Wire-Way for Photovoltaic Modules or Module Groups” to Almy was published on June 10, 2020, as U.S. Patent Publication No. 2010/0139731. EX1004, Cover. I understand that *Almy* is prior art to the ’291 Patent.

46. *Almy* teaches “a wire-based hanging wire-way” that supports bundles of electrical cables coupled to a plurality of photovoltaic module groups. *See, e.g., Id.*, ¶[0013]. The wire-based hanging wire-way “includes a wire-line with support loops. *Id.*, ¶[0018]. The support loops may be made from the same material as the wire-line, or may be separately fabricated from “galvanized steel, stainless steel, aluminum, nylon or clad copper.” *Id.*, ¶¶[0019], [0021]-[0022]. Each support loop is spaced apart from the next support loop and “is adapted to receive a bundle of electrical cable.” *Id.*, ¶22.



Id., Fig. 2B.

IX. Person of Ordinary Skill in the Art

47. As discussed above, the subject matter of the '291 Patent is directed to a cable hanger for suspending multiple conductors from a messenger wire in the solar, mining, and electrical industries.

48. Based on my understanding of the technology, education, and experience level of those working in this field, it is my opinion that a POSITA working in the field of the '291 Patent at the relevant time would have had a bachelor's degree in a pertinent discipline, such as electrical engineering, civil engineering, mechanical engineering or equivalent with 2-3 years of experience in electrical power systems, planning, and design, with the understanding that the number of years of experience could be higher or lower given the level of education and vice versa.

X. Invalidity Grounds

49. In general, I do not see anything that could be considered new or non-obvious as it relates to the '291 Patent claims. At the time of the filing of the application, as I have stated previously and as is recounted in the specifications, a cable hanger for suspending multiple conductors from a messenger wire was well-known in the art. The prior art discloses precisely the systems and methods claimed in the independent claims of the '291 Patent. There is nothing novel about the '291 Patent claims from a technical perspective, when viewed against the backdrop of the substantial prior art.

50. In particular, it is my opinion that the '291 Patent claims are invalid based on the following grounds. The cited references themselves alone and/or combination disclose the alleged invention for the same reasons and for the same objectives as described in the background section above.

Ground	Claims	Obviousness
1	1-13	<i>CAB Catalog</i> in view of the knowledge of a POSITA
2	14-23	<i>CAB Catalog</i> and <i>Almy</i> in view of the knowledge of a POSITA

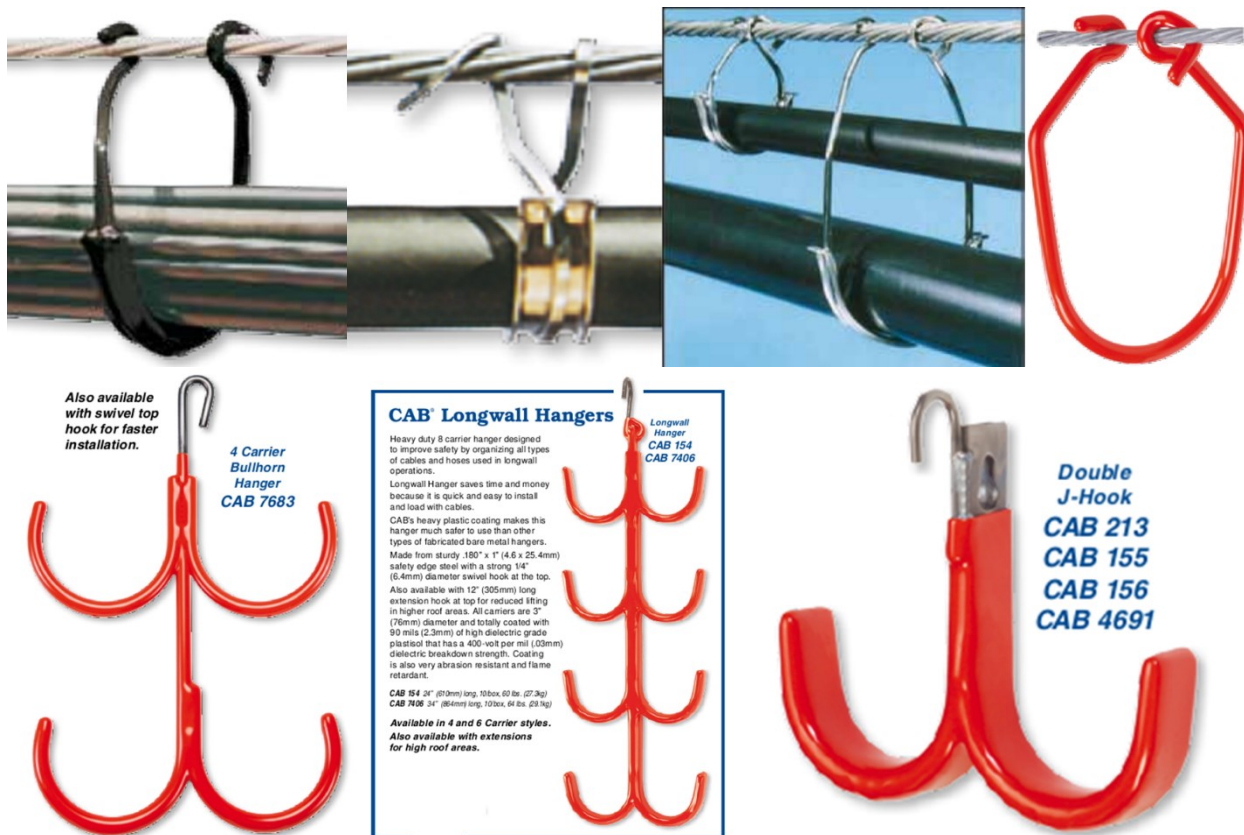
XI. GROUND 1: Obviousness over *CAB Catalog* in View the Knowledge of a POSITA

A. Claim-by-Claim Analysis

1. Independent Claim 1

a. Claim Element 1[a]: “A system for organizing a plurality of electrical cables extending from a plurality of solar panels, the system comprising:”

51. The *CAB Catalog* discloses a system of organizing a plurality of electrical cables comprising cable hangers, rings, saddles and clips suspended from a messenger wire. *See, e.g.*, EX1006, 5 (“CAB Bosserman Clips are widely respected for their superior ability to safely suspend electrical cables and wiring in a variety of underground applications.... Extra Long Styles available for running 2 cables separately from 1 messenger wire or large bundles of cables.”), 9 (“CAB Stacked J-Hooks Heavy duty 2-carrier hangers for supporting pipe and cables from roof, side or structure.”), 14 (“CAB Cable Rings are manufactured in standard, medium and long styles. Designed to tightly fit on an exact messenger wire size to prevent slippage. Medium and long style rings have extra length for bundles of cables or for running several cables independently from same messenger wire.”).



Id., 5, 9-11, 14.

52. The issue of cable management has long existed before the solar power system in electrical power distribution. As one example, IEEE Standard 525-2007 sets forth the standard for the design and installation of cable systems in substations for control and instrumentation cables, communication cables, fiber-optic cables, power cables for AC and DC systems below 1kV, and power cables for AC and DC systems between 1kV and 35kV. EX1022, 39-44 (§§7 and 8). As another example, IEEE 1185-2010 is IEEE's recommended practice for cable installation in generating stations and industrial facilities, which provides guidance for the installation of cable in trays, conduit, duct banks, wire ways, gutters, and other

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raceway systems. It covers medium voltage power cable, low voltage power cable, control cable, instrumentation cable, coax/triax cable, fiber optic cable, data communications cable, and other specialty cables used in power plant and industrial environments. This document may also be of benefit for the proper installation of wire and cable systems in commercial, governmental, and public facilities when the same or similar wire or cable types and raceways are used. EX1023. A POSITA looking to organize a plurality of cables in solar panels would have looked to cable management solutions in other electrical industries because cable organization and support was a problem common to a variety of electrical industries at the time of the invention. EX1001, 1:18-22 (“This invention has to do with a locking cable hanger system for use in the solar, mining, and electrical industries. In solar, mining, and electrical industries there is a need for electrical cables to extend from a power or signal source to a location of application.”).

53. Using the hangers described in the *CAB Catalog* to hang and organize solar cables would have been obvious to a POSITA. For example, the *CAB Catalog* recommends using the disclosed cable hangers “for aerial cables in plants, mills, tunnels, open pit mines and pipeline projects” and depicts the disclosed cables used in an aerial system. EX1006, 14. A POSITA would have understood that the reference to “plants” includes solar power plants, and the image depicting use on an aerial system suggests the hangers can be used in aerial cable support systems.



CAB Rings are recommended for aerial cables in plants, mills, tunnels, open pit mines and pipeline projects.



Id.

54. By way of further example, the CAB Catalog explains that the disclosed hangers are for “electrical cables,” and more specifically, “higher voltage and heavier load applications,” including for “hanging multiple cables from roof.” *Id.*, 9. A POSITA would have recognized that higher voltage and heavier load applications exist in the solar power context.

55. Using the *CAB Catalog* hangers to organize cables extending from solar panels would have yielded predictable results and reasonable expectation of success because (i) the *CAB Catalog* offers a hanger and support system that is spaced apart

and thus allows a POSITA to move the hangers to satisfy the IEEE Standard 142 and National Safety Code Rule 235G for vertical spacing between conductive cables, (ii) it would have been obvious to a POSITA to modify the *CAB Catalog* hangers where there was a need for multiple sets of cables when paralleling solar panels, and (iii) solar power systems use cables that are common in the electrical power distribution industry.

56. Therefore, “a system for organizing a plurality of electrical cables extending from a plurality of solar panels” is obvious in view of the *CAB Catalog*.

b. Claim Element 1[b]: “a messenger wire structured to be supported a distance above the ground; and”

57. The *CAB Catalog* explicitly discloses the use of a messenger wire to support cable hangers, rings, saddles and clips suspended from a messenger wire. *See, e.g.*, EX1006, 5 (“Extra Long Styles available for running 2 cables separately from 1 *messenger wire* or large bundles of cables.”), 8 (“Designed to hang from *messenger wire* or beltline structure”), 14 (“This advanced roll-form design, combined with the strong spring temper of the wire, provides a tight, secure attachment of the cable ring to the *messenger wire*.... CAB Cable Rings are manufactured in standard, medium and long styles. Designed to tightly fit on an exact *messenger wire* size to prevent slippage. Medium and long style rings have

extra length for bundles of cables or for running several cables independently from same messenger wire.”).



Id.

58. Therefore, the *CAB Catalog* discloses “a messenger wire structured to be supported a distance above the ground.”

- c. **Claim Element 1[c]: “a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables,”**

59. The *CAB Catalog* discloses a plurality of cable hangers disposed along, and suspended from, a messenger cable:



See EX1006.

60. The *CAB Catalog* also discloses cable hangers having a plurality (*i.e.*, more than one) of cable carrying surfaces. *See, e.g., id.*, 8-11.

CAB 903

CAB 905

CAB Plastic Telewire Hooks

Made from .085 x 1" (2.2 x 25.4mm) extruded PVC channel. Designed to hang from messenger wire or beltline structure. 5/8" (16mm) wide carriers. 15/16" (24mm) top hole. 1/4" (6.4mm) nylon nuts and bolts.



CAB 904



CAB 903 200/box, 8 lbs. (3.6kg)

CAB 904 with 90° offset, 200/box, 8 lbs. (3.6kg)

CAB 905 2 carrier, 50/box, 7 lbs. (3.2kg)

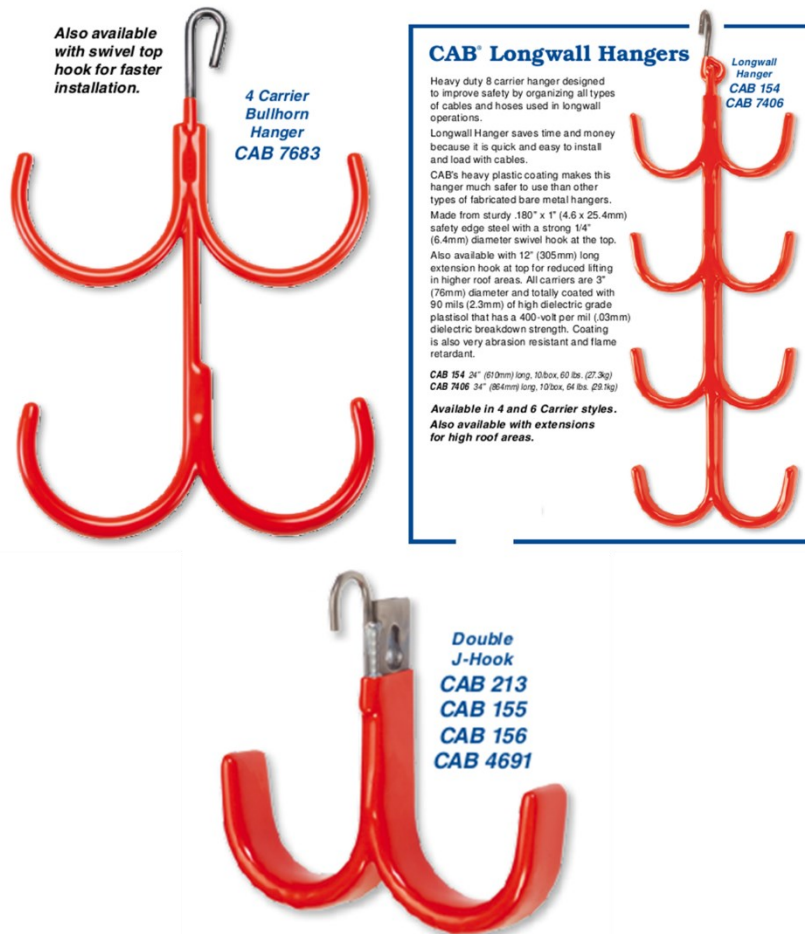
CAB 906 3 carrier, 50/box, 9 lbs. (4.1kg)

CAB 909 4 carrier, 50/box, 12 lbs. (5.5kg)

Affordable Wire Management, EX1002

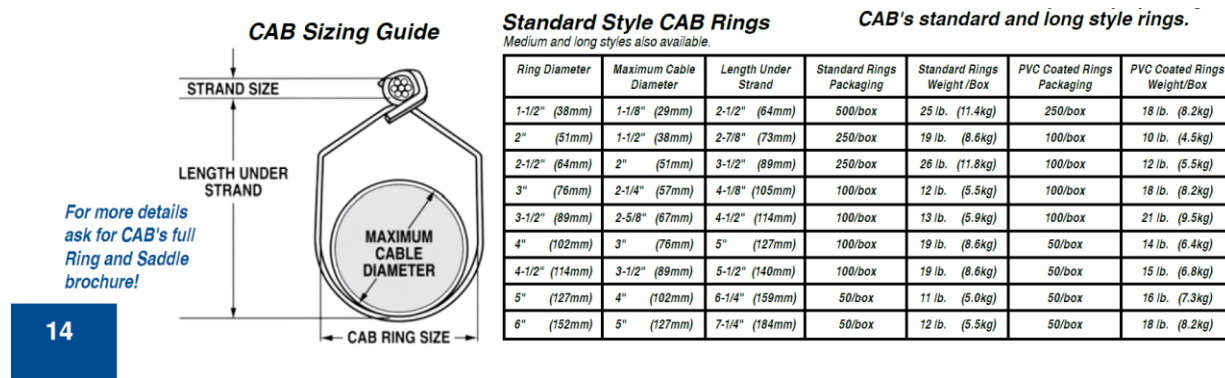
Case No. IPR2024-00182

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61. *CAB Catalog* also shows that each cable carrying surface is structured to support at least one electrical cable. *See, e.g.*, EX1006, 5 (“CAB Bosserman Clips are widely respected for their superior ability to safely suspend **electrical cables** and wiring”), 9 (“Safe, strong support for **electrical cables**, hoses and pipes.”), 14 (“CAB Cable Rings provide maximum strength and safety for the support of **all types of aerial cables**.... For added safety and protection, any style ring can be **totally insulated** with a tough, 80 mil (2mm) coating of **high dielectric grade** PVC plastisol.”).

62. Moreover, a POSITA would have found it obvious to modify CAB's cable clips, rings, and saddles to have a plurality of cable carrying surfaces. For example, the simple design of the CAB cable clips, rings, and saddles would allow a POSITA to modify their design to include additional cable carrying surfaces. Additionally, the *CAB Catalog* provides different sizing and configuration options for the disclosed hangers, including different sizes for the hook, length of the shoulder, and the diameter of the ring. *Id.*, 14. Based on this possible variety, it would have been obvious to a POSITA to modify the hangers along with the specified dimensions in the *CAB Catalog* or in a different configuration to allow for larger, smaller, or a plurality of cables to fit into the disclosed hangers. As an example, the hanger offered with a 6" ring diameter can fit a 5" cable diameter; but a POSITA would know that this same hanger can be modified to fit two cables having a 2" diameter, and if necessary, modified to include extra bends in the hanger to provide separate and divided areas for each of the cables to occupy.

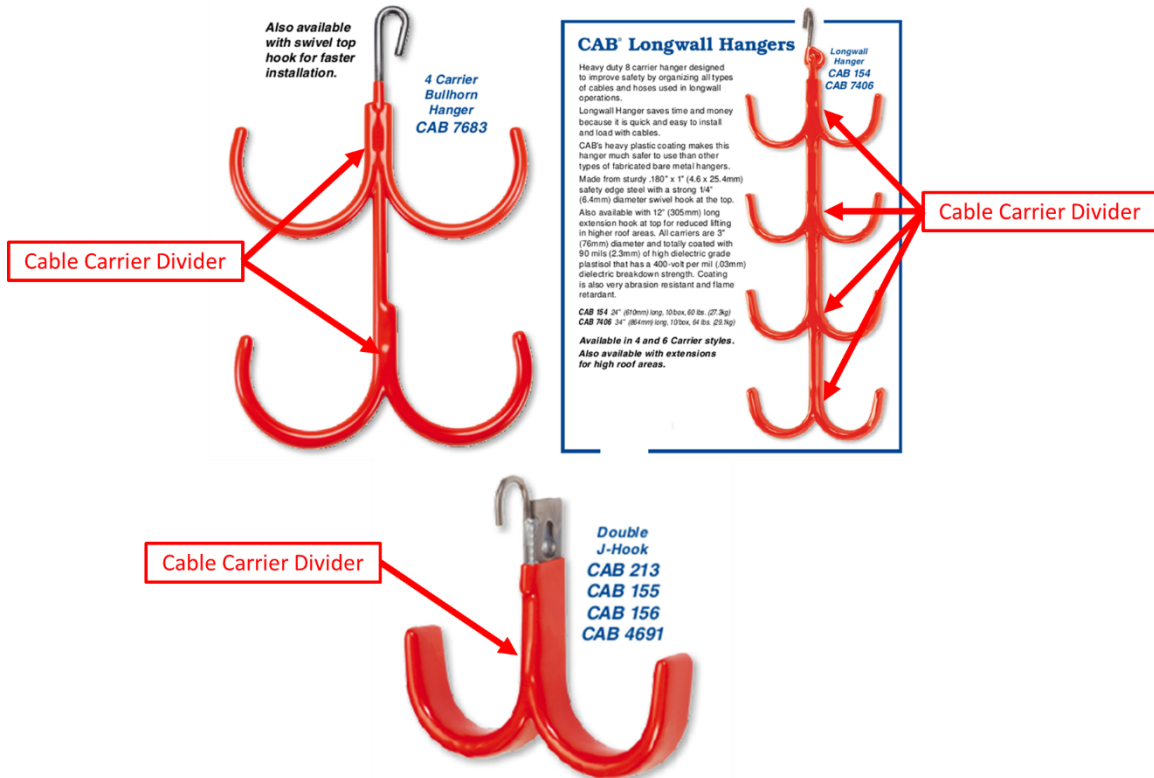


Id.

63. Thus, the *CAB Catalog* discloses “a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables.”

d. Claim Element 1[d]: “wherein adjacent cable carrying surfaces of the plurality of cable carrying surfaces are separated by a cable carrier divider.”

64. *CAB Catalog* renders this limitation obvious. *CAB Catalog* discloses several examples of cable hangers and J-hooks with a plurality of cable carrying surfaces. *E.g.*, EX1006, 9-11. As shown below, the cable hangers and J-hooks in *CAB Catalog* include a cable carrier divider between cable carrying surfaces:



Id.

65. Therefore, the *CAB Catalog* discloses the claim element “wherein adjacent cable carrying surfaces of the plurality of cable carrying surfaces are separated by a cable carrier divider.”

2. Independent Claim 6

- a. **Claim Element 6[a]: “A system for organizing a plurality of electrical cables extending from a plurality of solar panels, the system comprising:”**

66. Limitation 6[a] is identical to limitation 1[a]. As explained above, *CAB Catalog* renders this limitation obvious. *See* §XI.A.1.a.

- b. Claim Element 6[b]: “a messenger wire structured to be supported a distance above the ground; and”**

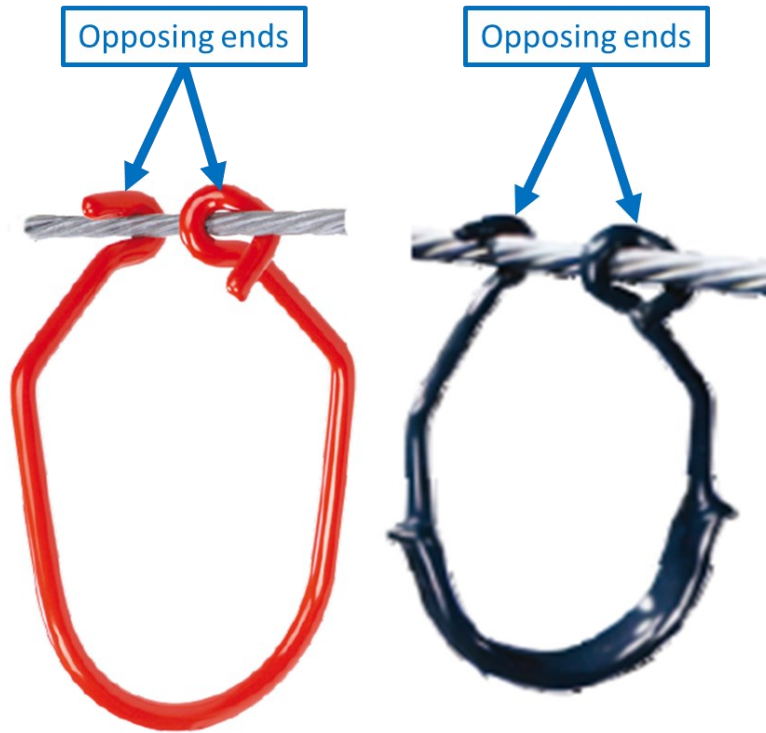
67. Limitation 6[b] is identical to limitation 1[b]. As explained above, *CAB Catalog* renders this limitation obvious. *See* §XI.A.1.b.

- c. Claim Element 6[c]: “a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables, wherein each cable hanger of the plurality of cable hangers comprises:”**

68. Limitation 6[c] is analogous to limitation 1[c]. As explained above, *CAB Catalog* renders this limitation obvious. *See* §XI.A.1.c.

- d. Claim Element 6[d]: “a high tensile strength wire with two opposing ends and configured intermediate of said ends to form a plurality of substantially U-shaped configurations each having a cable carrying surface of the plurality of cable carrying surfaces located thereon;”**

69. *CAB Catalog* discloses that its cable clips, rings, and saddles are “manufactured from high tensile spring steel in rolled flat wire form.” EX1006, 5, 14. *CAB Catalog* makes clear that the cable clips, rings, and saddles are made from a single piece of wire with two opposing ends:



Id.

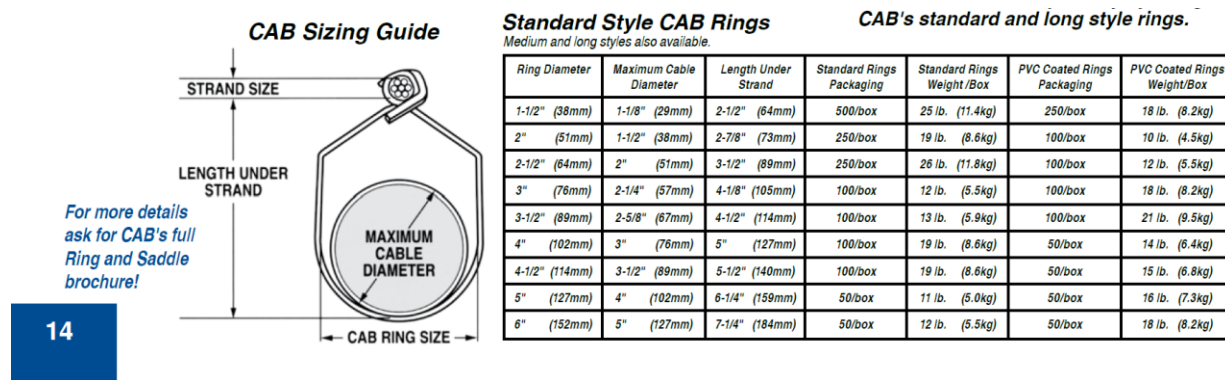
70. The *CAB Catalog* also discloses hangers having a U-shaped configurations for supporting a plurality of hangers. As shown in the annotated figure below, *CAB Catalog*'s cable clips, rings, and saddles form substantially U-shaped configurations each having a cable carrying surface:



Id.

71. Moreover, a POSITA would have found it obvious to modify CAB's cable clips, rings, and saddles to have a plurality of U-shaped cable carrying surfaces. For example, the simple design of the CAB cable clips, rings, and saddles would allow a POSITA to modify their design to include additional cable carrying

surfaces. Additionally, the *CAB Catalog* provides different sizing and configuration options for the disclosed hangers, including different sizes for the hook, length of the shoulder, and the diameter of the ring. *Id.*, 14. Based on this possible variety, it would have been obvious to a POSITA to modify the hangers along with the specified dimensions in the *CAB Catalog* or in a different configuration to allow for larger, smaller, or a plurality of cables to fit into the disclosed hangers. As an example, the hanger offered with a 6” ring diameter can fit a 5” cable diameter; but a POSITA would know that this same hanger can be modified to fit two cables having a 2” diameter, and if necessary, modified to include extra bends in the hanger to provide separate and divided areas for each of the cables to occupy.

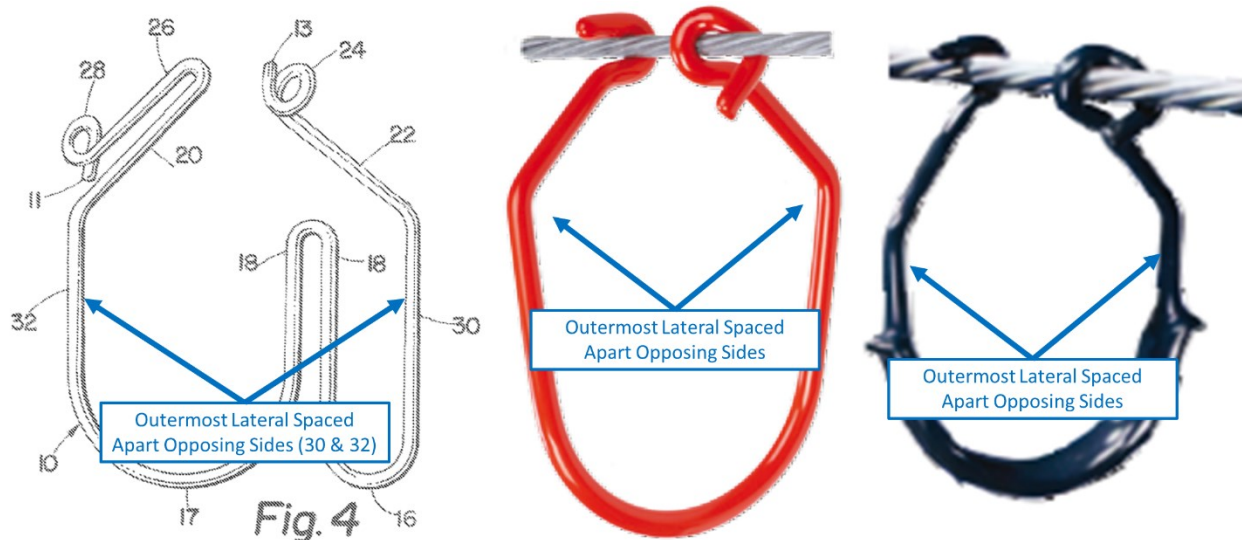


Id.

72. Therefore, the *CAB Catalog* discloses “a high tensile strength wire with two opposing ends and configured intermediate of said ends to form a plurality of substantially U-shaped configurations each having a cable carrying surface of the plurality of cable carrying surfaces located thereon.”

e. **Claim Element 6[e]: “outermost lateral spaced apart opposing sides forming the boundary of said hanger;”**

73. As shown in the annotated figure below, the *CAB Catalog*’s cable clips, rings, and saddles each have outermost lateral spaced apart opposing sides:

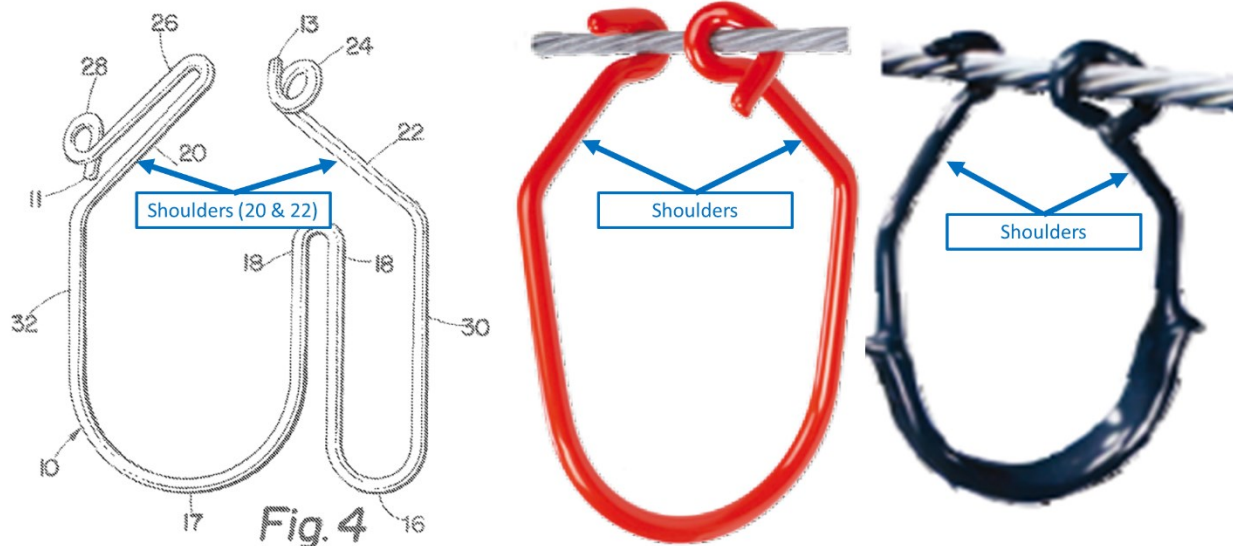


EX1006, 5, 14.

74. Therefore, the *CAB Catalog* discloses an “outermost lateral spaced apart opposing sides forming the boundary of said hanger.”

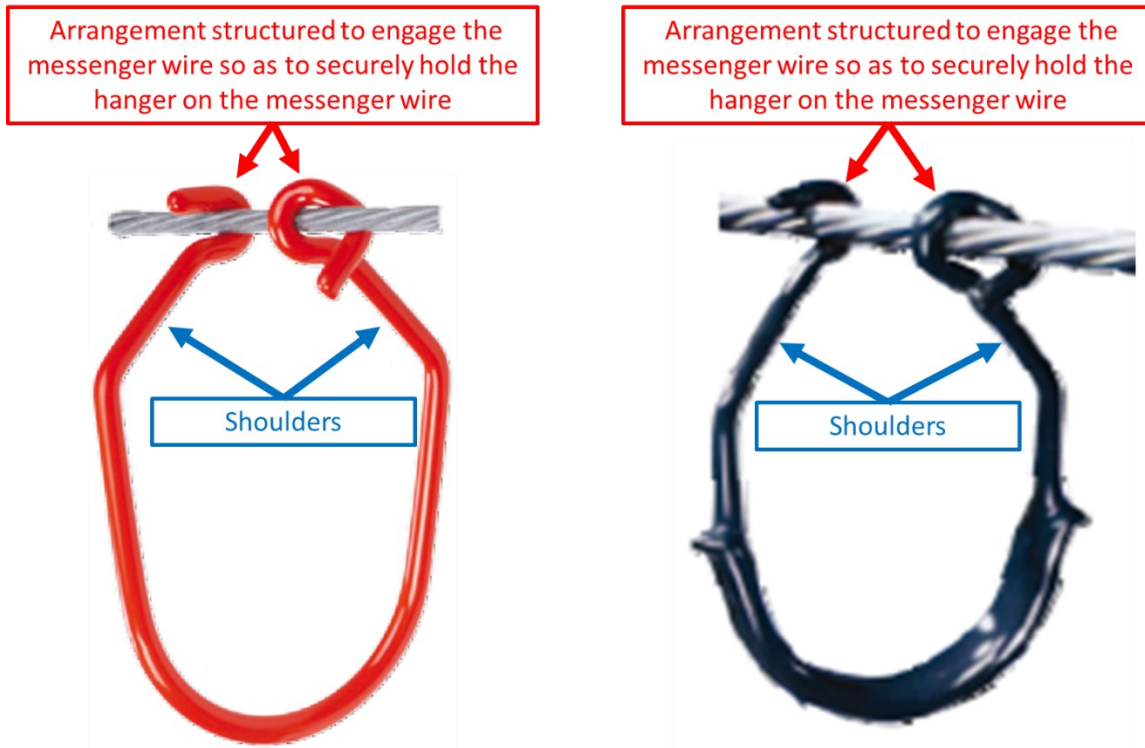
f. **Claim Element 6[e]: “outermost lateral spaced apart opposing sides forming the boundary of said hanger;”**

75. As shown in the annotated figure below, *CAB Catalog*’s cable clips, rings, and saddles each have shoulders extending toward each other from said spaced apart opposite sides:



EX1006, 5, 14.

76. Further, *CAB Catalog*'s cable clips, rings, and saddles each have “an arrangement structured to engage the messenger wire so as to securely hold the hanger on the messenger wire”:



Id.

77. Therefore, the *CAB Catalog* discloses “opposite shoulders extending toward each other from said spaced apart opposite sides, each of said shoulders having an arrangement structured to engage the messenger wire so as to securely hold the hanger on the messenger wire.”

3. Dependent Claims

- a. **Claims 2, 3, 4: “The system of claim 1, wherein the plurality of cable carrying surfaces comprises at least [three/four/five] cable carrying surfaces.”**

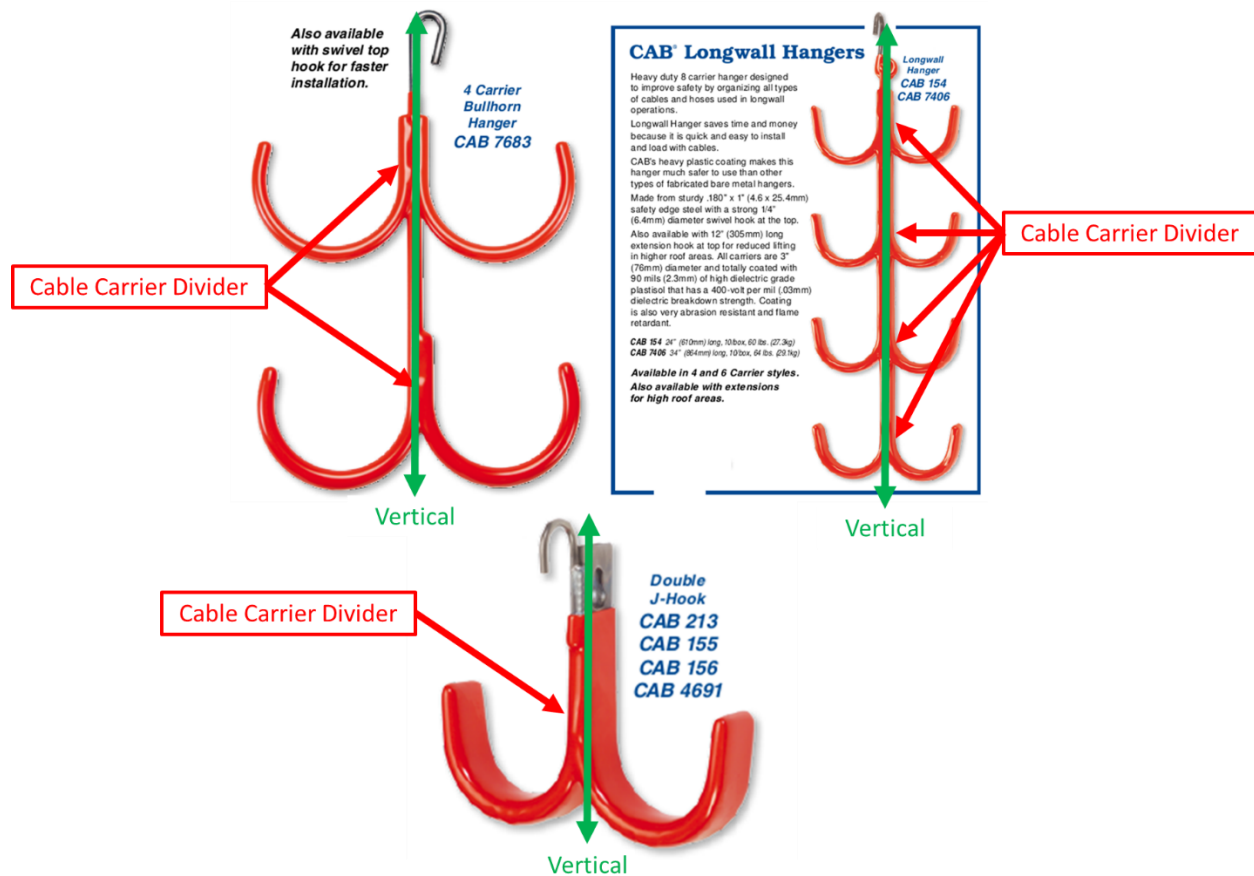
78. As shown below, the *CAB Catalog* discloses several examples of cable hangers and J-hooks with a three, four, five, or more cable carrying surfaces:

shaped cable carrying surfaces. For the same reasons, a POSITA would know that the hangers can be modified to include multiple extra bends in the hanger to provide separate and divided areas for the desired number of cables to occupy.

80. Therefore, the *CAB Catalog* discloses the claim elements “wherein the plurality of cable carrying surfaces comprises at least [three/four/five] cable carrying surfaces.”

b. Claim 5: “The system of claim 1, wherein the cable carrier divider extends vertically.”

81. The *CAB Catalog* discloses several examples of cable hangers and J-hooks with a plurality of cable carrying surfaces. *E.g.*, EX1006, 9-11. As shown below, the cable hangers and J-hooks in *CAB Catalog* include a cable carrier divider extending vertically between cable carrying surfaces:



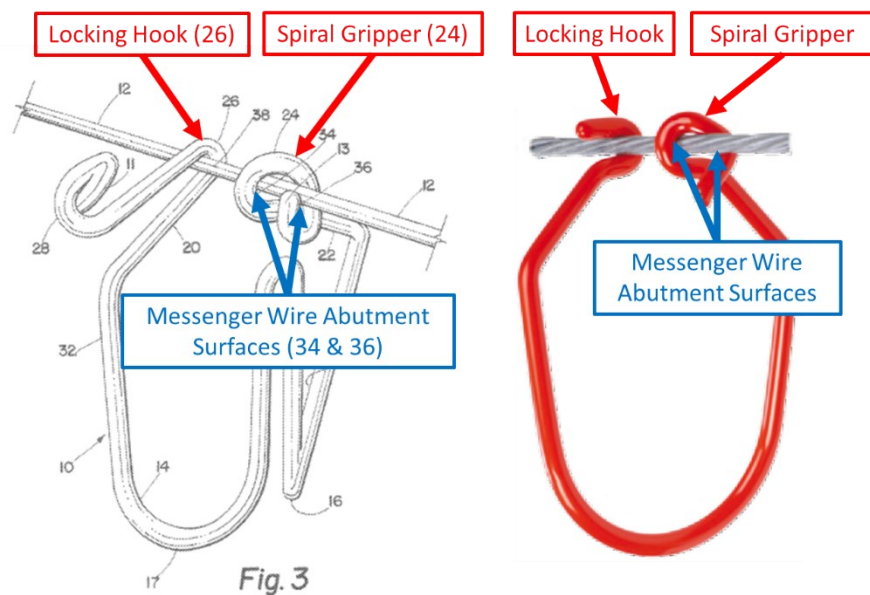
EX1006, 9-11.

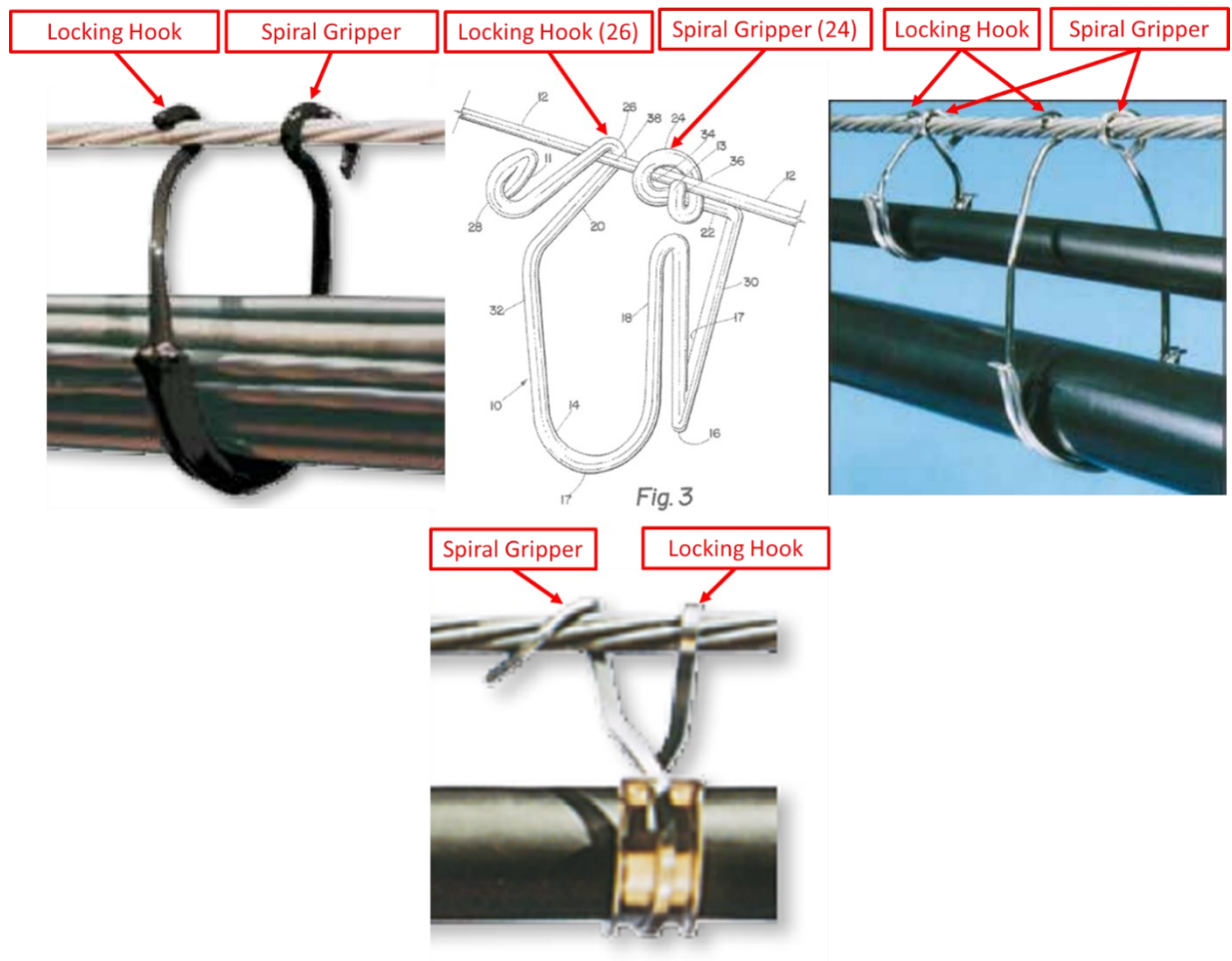
82. Therefore, the *CAB Catalog* discloses the claim element “wherein the cable carrier divider extends vertically.”

- c. **Claim 7:** “The system of claim 6, wherein the arrangement of one of the shoulders that is structured to engage the messenger wire is a spiral gripper formation and the arrangement of the other shoulder that is structured to engage the messenger wire is a locking hook.”

83. The *CAB Catalog*’s description and depiction of the “Bosserman Clips” explicitly discloses the “spiral gripper” and “locking hook” limitations. As shown in

the figures below, *CAB Catalog*'s Bosserman clips feature shoulders have a “locking arm” which engages the messenger wire at two points on the messenger wire. Further, the disclosed hanger fully engages the messenger wire when the lateral sides are squeezed so that S1 and S2 (shoulders) come towards each other and locking hook *h2*, located on the opposite shoulder to the spiral gripper, comes under the messenger wire ST and engages the messenger wire:





EX1006, 5, 14.

84. Therefore, the *CAB Catalog* discloses the claim element “wherein the arrangement of one of the shoulders that is structured to engage the messenger wire is a spiral gripper formation and the arrangement of the other shoulder that is structured to engage the messenger wire is a locking hook.”

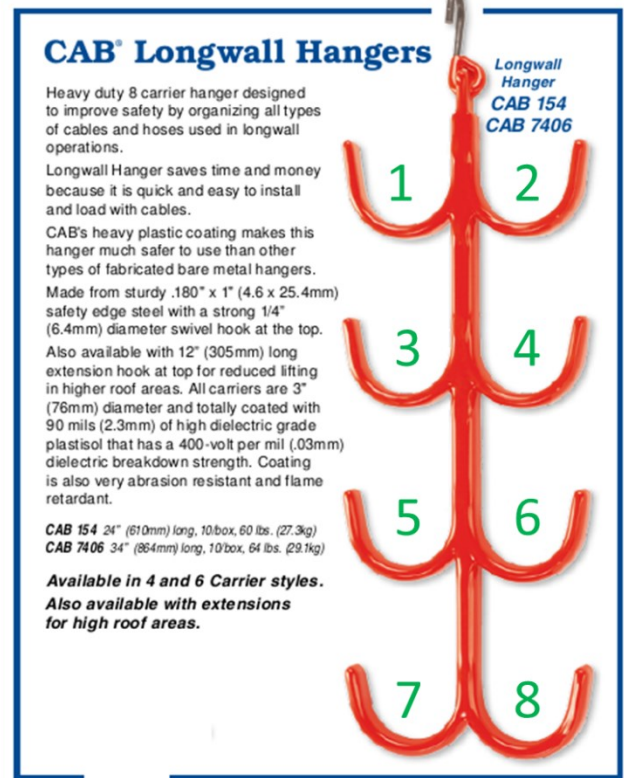
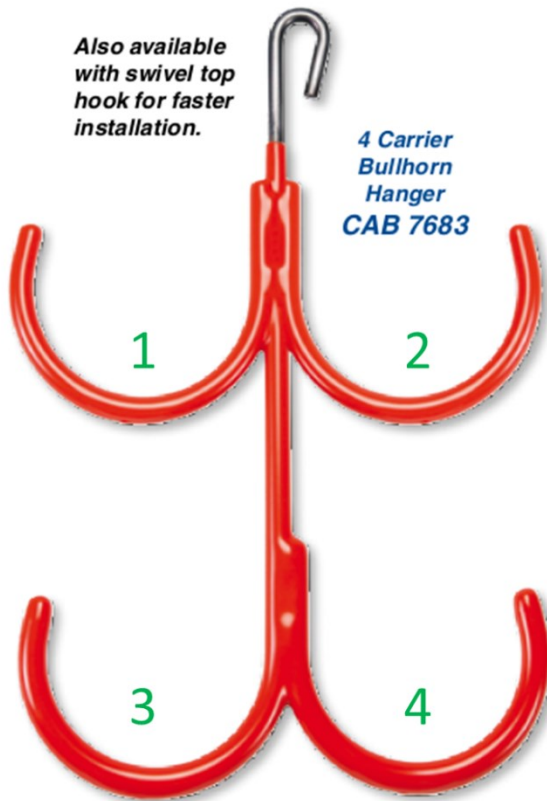
- d. **Claims 8: “The system of claim 1, wherein each cable hanger of the plurality of cable hangers comprises a wire selected from the group of round galvanized steel, round stainless steel, flat rolled galvanized steel, flat rolled stainless steel.”**

85. The *CAB Catalog* explicitly discloses that its cable rings and saddles are manufactured from high tensile wire made of “galvanized steel, copper clad steel or type 316 stainless steel.” EX1006, 14.

86. Therefore, the claim element “wherein each cable hanger of the plurality of cable hangers comprises a wire selected from the group of round galvanized steel, round stainless steel, flat rolled galvanized steel, flat rolled stainless steel” is obvious in view of the *CAB Catalog*.

- e. **Claim 9: “The system of claim 1, wherein each cable hanger of the plurality of cable hangers further comprises a formation structured to support a data carrier.”**

87. The *CAB Catalog* discloses a cable hanger with a plurality of cable carrying surfaces, all of which are suitable to support a data carrier separately from current-carrying cables. For example, in annotated the annotated figures below, a POSITA would understand that a data carrier could be supported on surfaces 1 or 2, while current-carrying cables could be supported on at least surfaces 3-8, or vice versa.

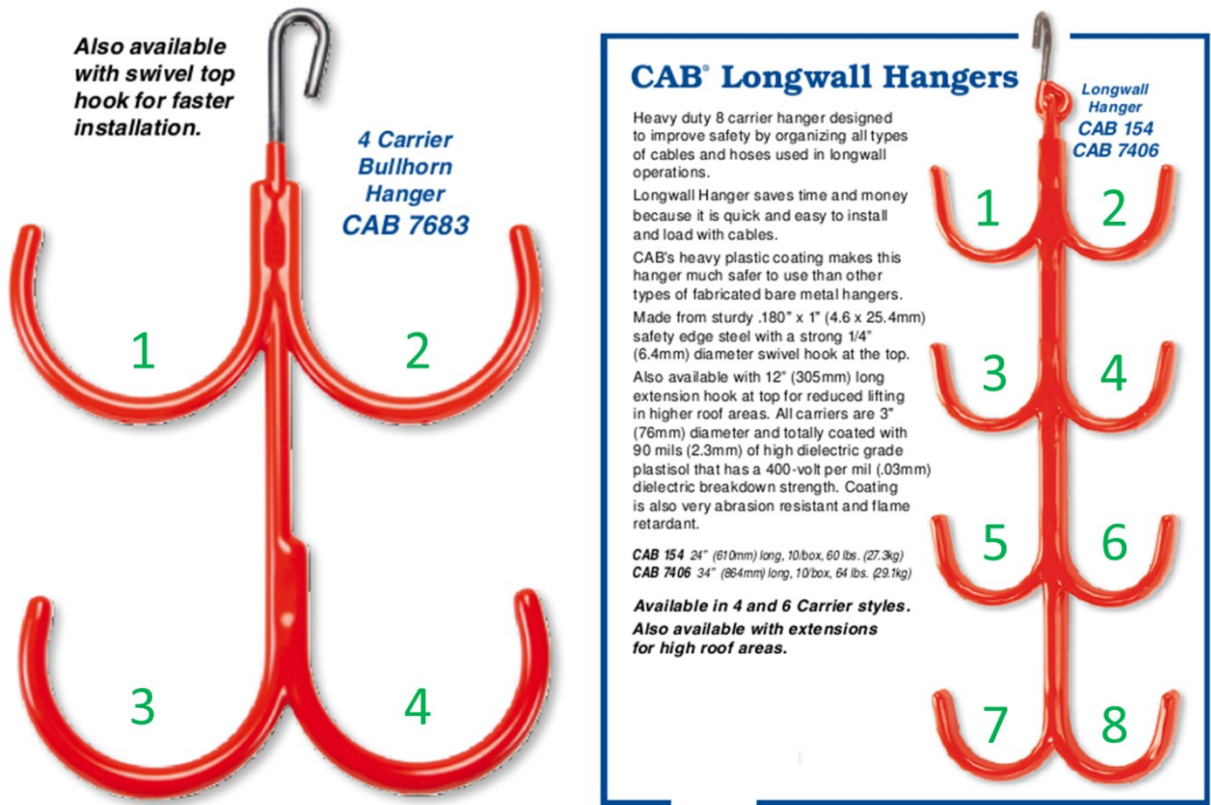


EX1006, 10-11. A POSITA would have positioned a data carrier separate from the current-carrying cables because, as explained above in Section VI.B, a POSITA would have understood that interference from current-carrying cables was a known risk.

88. Therefore, the *CAB Catalog* discloses the claim element “wherein each cable hanger of the plurality of cable hangers further comprises a formation structured to support a data carrier.”

- f. Claim 10: “The system of claim 9, wherein the formation structured to support the data carrier is positioned closer to the messenger wire than the cable carrying surfaces.”**

89. As discussed in Section XI.A.3.e, *CAB Catalog* discloses a cable hanger with a formation structured to support a data carrier. It would have been an obvious choice to position the data carrier closer to the messenger than the current-carrying cables. IEEE Standard 142 explains that the magnetic field that is created by the current carrying cable would interfere with the data carrier, causing disturbances, and possible distortion of data. EX1019, 87-104 (Section 2.2). For example, in the annotated figures below, a POSITA would understand that a data carrier could be supported on surfaces 1 or 2, while current-carrying cables could be supported on at least surfaces 3-8.



EX1006, 10-11. A POSITA would have sought to maximize the distance between the data carrier and the current-carrying cables because, as explained above in Section VI.B, a POSITA would have understood that interference from current-carrying cables was a known risk. Positioning the data carrier at the extreme upper end of the hanger structure would allow a POSITA to position the current-carrying cables on lower tiers and minimize the risk of interference.

90. Therefore, the *CAB Catalog* discloses the claim element “wherein the formation structured to support the data carrier is positioned closer to the messenger wire than the cable carrying surfaces.”

- g. **Claim 11: “The system of claim 1, wherein each cable hanger of the plurality of cable hangers includes a plastisol or PVC coating.”**

91. The cable hangers, cable hooks, cable rings, and cable saddles disclosed in the *CAB Catalog* have plastisol coating. *See, e.g.*, EX1006, 2 (“100% ***Plastisol Coated*** Round Wire Cable Clips”), 3 (“All hanger carrying surfaces are fully insulated with a tough, high dielectric grade, flame retardant ***plastisol coating.***”), 5 (“CAB Bosserman Clips feature a 100% ***plastisol coated*** high tensile spring steel body”), 10 (All carriers are ... totally ***coated with*** 90 mils (2.3mm) of ***high dielectric grade plastisol***”), 14 (“any style ring can be totally insulated with a tough, 80 mil (2mm) ***coating of high dielectric grade PVC plastisol.***”).

92. Further, *CAB Catalog* provides an express motivation to coat cable hangers, cable hooks, cable rings, and cable saddles with plastisol: it repeatedly explains that the coating provides the “added safety and protection” of being an insulator (*i.e.*, is dielectric), resisting abrasion, resisting corrosion, and being flame retardant. *See id.*

93. Therefore, the *CAB Catalog* discloses the claim limitation “wherein each cable hanger of the plurality of cable hangers includes a plastisol or PVC coating.”

h. Claim 12: “The system of claim 11, wherein the coating has a thickness in the range of from 50 mils to 100 mils thick.”

94. When discussing the coating on the CAB Cable Rings and Saddles that are used with a messenger wire, the *CAB Catalog* explains that “[f]or added safety and protection, any style ring can be totally insulated with a tough, **80 mil (2mm) coating of high dielectric grade PVC plastisol.**” EX1006, 14. More broadly, the cable hangers, cable hooks, cable rings, and cable saddles disclosed in the *CAB Catalog* all have plastisol coating within the claimed 50 mils to 100 mils range. *See, e.g., id.*, 10 (All carriers are 3” in diameter and totally **coated with 90 mils (2.3mm) of high dielectric grade plastisol**). Both 80 mils and 90 mils are squarely within the claimed range of 50-100 mils thick.

95. Additionally, *CAB Catalog* provides an express motivation to coat cable hangers, cable hooks, cable rings, and cable saddles with plastisol within the claimed range: it explains that coating of that thickness provides strong (“total”) insulation, is very abrasion resistant, and is flame retardant, providing abrasion resistance, and being flame retardant. *See* EX1006, 10, 14.

96. Therefore, the *CAB Catalog* discloses the claim limitation “wherein the coating has a thickness in the range of from 50 mils to 100 mils thick.”

- i. **Claim 13: “The system of claim 1, wherein each cable hanger of the plurality of cable hangers includes a coating having a flame retardant, high dielectric grade, UV inhibited material.”**

97. The cable hangers, cable hooks, cable rings, and cable saddles disclosed in the *CAB Catalog* all have plastisol coating that is a “flame retardant, high dielectric grade, UV inhibited material.” *See, e.g.*, EX1006, 2 (“coated over the entire surface with abrasion resistant, ***high dielectric grade plastisol*** for total insulation”), 3 (“All hanger carrying surfaces are fully insulated with a tough, ***high dielectric grade, flame retardant plastisol coating.***”), 5 (“***High dielectric grade plastisol*** applied on 100% of the hanger surface”), 10 (All carriers are ... totally ***coated with*** 90 mils (2.3mm) of ***high dielectric grade plastisol*** Coating is also very abrasion resistant and ***flame retardant.***”), 14 (“any style ring can be totally insulated with a tough, 80 mil (2mm) ***coating of high dielectric grade PVC plastisol....*** CAB’s Award Winning PVC coated Rings and Saddles have a heavy coating of ***high dielectric grade, UV stabilized PVC plastisol.***”).

98. Additionally, *CAB Catalog* provides an express motivation to coat cable hangers, cable hooks, cable rings, and cable saddles with plastisol within the claimed range: it explains that coating of that thickness provides strong (“total”) insulation, is very abrasion resistant, and is flame retardant, providing abrasion resistance, and being flame retardant. *See* EX1006, 10, 14.

99. Therefore, the *CAB Catalog* discloses the claim limitation “wherein each cable hanger of the plurality of cable hangers includes a coating having a flame retardant, high dielectric grade, UV inhibited material.”

XII. GROUND 2: Obviousness over *CAB Catalog* and *Almy* in View the Knowledge of a POSITA

A. Motivation to Combine

100. The *CAB Catalog* discloses a variety of hangers for supporting “electrical cables” from messenger wire, plates, or other structures. EX1006, 2, 8-9. The “multi carrier hooks” described in *CAB Catalog* are designed to organize “sensor, communication, control and electrical wiring [and is] useful ... when running multiple cables.” *Id.*, 7. Thus, *CAB Catalog* teaches multi-carrier hooks and hangers for suspending electrical cables from structures such as a messenger wire.

101. Like the *CAB Catalog*, *Almy* is directed to “supporting bundles of electrical cables.” EX1004, ¶[0002]. *Almy* recognizes the need for a “wire-based hanging wire-way for ... supporting a bundle of electrical cables between photovoltaic modules or module groups.” *Id.*, ¶[0012]. For this need, *Almy* teaches the use of “a plurality of periodic independent wire loops.” *Id.*, ¶[0022]. Each such wire loop “is adapted to receive a bundle of electrical cables.” *Id.* The diameter of each wire loop depends on the “thickness of the bundle of electrical cables at a particular point, e.g. between specific photovoltaic module groups.” *Id.* Thus, *Almy*

discloses a cable support system with wire loops for supporting bundles of cables extending from solar panels.

102. Combining the teachings of *CAB Catalog* and *Almy* would have involved routine implementation, would have posed no technical risk given their complementary teachings, and would have achieved predicable benefits of improving wire runs in solar installations by separating conductors and implementing a more robust hanger. A POSITA would have recognized the disadvantages of using wire loops to suspend conductors from a messenger wire. Bundling cables with zip-ties, cable-ties, or other lashings such as wire loops provide temporary solutions but cannot be used permanently in power systems. A POSITA would have known that the ties, if plastic, may melt during high short circuit currents or fires, have limited capacity for supporting weight, and will deflect over time even if they are made of metal. Further, standard IEC 62275 specifies performance rating categories for cable ties which include, Mechanical, Thermal, Environmental, and Fire Effects. Additionally, separation of different types of cables such as data from current-carrying cables would pose significant challenges when using wire loops. Wire loops are also not able to provide the required distance between sets of cables for both current-carrying and non-current-carrying to prevent cross-linking as set forth by IEEE Standard 142, and NEC Rule 235G. Finally, a POSITA would

recognize that separating bundles of cables could result in beneficial with thermal profiles (*e.g.*, 2 bundles of 6 cables are better than 1 bundle of 12).

103. To solve these challenges a POSITA would have been motivated to replace the wire loops and wire-way from *Almy* with a more permanent hanger system such as those disclosed in the *CAB Catalog*.

B. Claim-by-Claim Analysis

1. Independent Claim 14

a. Claim Element 14[a]: “A solar plant comprising:”

104. *Almy* discloses a solar plant comprising a plurality of photovoltaic modules (*i.e.*, solar panels), cabling between those solar panels, and a system for organizing that cabling. *See, e.g.* EX1004 (“A plurality of photovoltaic modules or module groups may be electrically coupled to an electrical power distribution network, forming a photovoltaic system. Ground based power distribution networks require significant cabling between photovoltaic modules or discrete groups of modules, such as trackers or rows.... A wire-based hanging wire-way for photovoltaic modules or module groups and methods for supporting a bundle of electrical cables between photovoltaic modules or module groups are described herein.”).

105. Because cable organization and support was a problem common to a variety of industries, a POSITA looking to organize a plurality of electrical cables

within a solar plant would have also looked to cable management solutions in the mining industry. EX1001, 1:18-22 (“This invention has to do with a locking cable hanger system for use in the solar, mining, and electrical industries. In solar, mining, and electrical industries there is a need for electrical cables to extend from a power or signal source to a location of application.”). Thus, there was ample motivation to combine the hangers disclosed in *CAB Catalog* with the solar plant wire management system of *Almy*.

106. Therefore, *Almy* discloses “a solar plant.”

b. Claim Element 14[b]: “a plurality of solar panels;”

107. *Almy* discloses “a plurality of photovoltaic modules or module groups.” EX1004, ¶[0003]; *see also supra* Section XII.B.1.a. Photovoltaic modules are also known as “solar panels.” Therefore, *Almy* discloses “a plurality of solar panels.”

c. Claim Element 14[c]: “a plurality of electrical cables extending from the plurality of solar panels; and”

108. *Almy* discloses, for example, “[a] plurality of photovoltaic modules or module groups may be *electrically coupled* to an electrical power distribution network, forming a photovoltaic system. Ground based power distribution networks *require significant cabling between photovoltaic modules or discrete groups of modules*, such as trackers or rows.... A wire-based hanging wire-way for photovoltaic modules or module groups and methods *for supporting a bundle of*

electrical cables between photovoltaic modules or module groups are described herein.” *E.g.* EX1004.

109. Therefore, *Almy* discloses “a plurality of electrical cables extending from the plurality of solar panels.”

d. Claim Element 14[d]: “a system for organizing the plurality of electrical cables, the system comprising:”

110. Limitation 14[d] is analogous to limitation 1[a]. As explained above, *CAB Catalog* and *Almy*, together or individually, renders this limitation obvious. *See* §XI.A.1.a.

e. Claim Element 14[e]: “a messenger wire supported a distance above the ground adjacent the solar panels; and”

111. Limitation 14[e] is identical to limitation 1[b]. As explained above, *CAB Catalog* renders this limitation obvious. *See* §XI.A.1.b.

f. Claim Element 14[f]: “a plurality of cable hangers disposed along, and suspended from the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables,”

112. Limitation 14[f] is analogous to limitation 1[c]. As explained above, *CAB Catalog* renders this limitation obvious. *See* §XI.A.1.c.

- g. Claim Element 14[g]: “wherein adjacent cable carrying surfaces of the plurality of cable carrying surfaces are separated by a cable carrier divider.”**

113. Limitation 14[g] is identical to limitation 1[d]. As explained above, *CAB Catalog* renders this limitation obvious. See §XI.A.1.d.

2. Independent Claim 19

- a. Claim Element 19[a]: “A solar plant comprising:”**

114. Limitation 19[a] is identical to limitation 14[a]. As explained above, *Almy* renders this limitation obvious. See §XII.B.1.a.

- b. Claim Element 19[b]: “a plurality of solar panels;”**

115. Limitation 19[b] is identical to limitation 14[b]. As explained above, *Almy* renders this limitation obvious. See §XII.B.1.b.

- c. Claim Element 19[c]: “a plurality of electrical cables extending from the plurality of solar panels; and”**

116. Limitation 19[c] is identical to limitation 14[c]. As explained above, *Almy* renders this limitation obvious. See §XII.B.1.c.

- d. Claim Element 19[d]: “a system for organizing the plurality of electrical cables, the system comprising:”**

117. Limitation 19[d] is analogous to limitation 1[b]. As explained above, *CAB Catalog* renders this limitation obvious. See §XI.A.1.b.

- e. Claim Element 19[e]: “a messenger wire supported a distance above the ground adjacent the solar panels; and”**

118. Limitation 19[e] is analogous to limitation 1[c]. As explained above, *CAB Catalog* renders this limitation obvious. See §XI.A.1.c.

- f. Claim Element 19[f]: “a plurality of cable hangers disposed along, and suspended from the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables,”**

119. Limitation 19[f] is identical to limitation 14[f] and analogous to limitation 1[c]. As explained above, *CAB Catalog* renders this limitation obvious. See §§XI.A.1.c, XII.A.1.b.

- g. Claim Element 19[g]: “wherein each cable hanger of the plurality of cable hangers comprises: “a high tensile strength wire with two opposing ends and configured intermediate of said ends to form a plurality of substantially U-shaped configurations each having a cable carrying surface of the plurality of cable carrying surfaces located thereon;”**

120. Limitation 19[g] is analogous to limitation 6[d]. As explained above, *CAB Catalog* renders this limitation obvious. See §XI.A.2.d.

- h. Claim Element 19[i]: “opposite shoulders extending toward each other from said spaced apart opposite sides, each of said shoulders having an arrangement structured to engage the messenger wire so as to securely hold the hanger on the messenger wire.”**

121. Limitation 19[i] is analogous to limitation 6[e]. As explained above, *CAB Catalog* renders this limitation obvious. See §XI.A.2.e.

3. Dependent Claims

- a. Claims 15, 16, and 17: “The solar plant of claim 14, wherein the plurality of cable carrying surfaces comprises at least [three/four/five] cable carrying surfaces.”**

122. Outside of the recitation of “the solar plant,” the limitations of claims 15, 16, and 17 are identical to the limitations of claims 2, 3, and 4, respectively. As explained above, the *CAB Catalog* discloses these limitations. See §XI.A.3.a.

- b. Claim 18: “The solar plant of claim 14, wherein the cable carrier divider extends vertically.”**

123. Outside of the recitation of “the solar plant,” the limitation of claim 18 is identical to the limitation of claim 5. As explained above, the *CAB Catalog* discloses these limitations. See §XI.A.3.b.

- c. Claim 20: “The solar plant of claim 14, wherein each cable hanger of the plurality of cable hangers comprises a wire selected from the group of round galvanized steel, round stainless steel, flat rolled galvanized steel, flat rolled stainless steel.”**

124. Outside of the recitation of “the solar plant,” the limitation of claim 20 is identical to the limitation of claim 8. As explained above, the *CAB Catalog* discloses these limitations. See §XI.A.3.d. Further, *Almy* discloses cable-carrying loops constructed from wire made of materials including galvanized steel and stainless steel. EX1004, [0020]. A POSITA at the time of the invention would have understood *Almy* to explicitly disclose the “round steel,” “galvanized steel,” and “stainless steel” limitations of claim 20 and render obvious the “flat rolled” steel limitations of those claims.

- d. Claim 21: “The solar plant of claim 14, further comprising a data carrier associated with the plurality of solar panels, and wherein each cable hanger of the plurality of cable hangers further comprises a formation structured to support the data carrier along the messenger wire.”**

125. The limitation of claim 21 is analogous to the limitation of claim 9. As explained above, the *CAB Catalog* discloses these limitations. See §XI.A.3.e.

- e. **Claim 22: “The solar plant of claim 21, wherein, for each cable hanger, the formation structured to support the data carrier is positioned closer to the messenger wire than the cable carrying surfaces.”**

126. The limitation of claim 22 is analogous to the limitation of claim 10.

As explained above, the *CAB Catalog* discloses these limitations. See §XI.A.3.f.

- f. **Claim 23: “The solar plant of claim 14, wherein each cable hanger of the plurality of cable hangers includes a plastisol, PVC coating, and/or a coating having a flame retardant, high dielectric grade, UV inhibited material.”**

127. The limitation of claim 23 is analogous to the limitations of claims 11 and 13. As explained above, the *CAB Catalog* discloses these limitations. See §§XI.A.3.g, XI.A.3.i.

XIII. Considerations of Non-Obviousness

128. As explained above, I understand that “objective indicia of non-obviousness,” also known as “secondary considerations,” are also to be considered when assessing obviousness of the claims, if such factors are present. These include commercial success of the claimed invention; long felt but unresolved needs; failure of others to solve the problem that the inventor solved; unexpected results; copying of the invention by others; and industry recognition or expressions of disbelief by experts in the field of the claimed invention. I also understand that in considering objective indicia of nonobviousness, it is not proper to look beyond the scope of the claimed subject matter.

129. In my opinion, the '291 Patent did not resolve any long-felt need. Rather, the '291 Patent presented known options for suspending multiple conductors from messenger wires. For the same reasons, I am not aware of any failure of others to solve the problem identified by the inventor; any unexpected results resulting from the chosen solution, which was known in the art; or any industry recognition or praise regarding this particular claimed invention. In fact, others succeeded in designing similar cable hangers (e.g., Caveney, Carr, Jessen, Hendrix, and SnakeTray) and suggested the use of similar cable hangers (e.g., CAB's 2010 product catalog, UL's 1984 report, and the U.S. Army's 1996 Technical Manual) well before the inventor of the '291 Patent.

130. I am also not aware of any other secondary considerations that weigh against the obviousness of the claims, for example, commercial success or copying. Even if evidence of secondary considerations existed, in my opinion, it would be insufficient to overcome the clear obviousness of the challenged claims (claims 1-23 of the '291 Patent), as explained above.

XIV. Conclusion

131. I declare that all statements made in this declaration based on my own knowledge and experience are true to the best of my knowledge and that any statements made on information and belief are believed to be true.

132. I further declare that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: November 10, 2023

A handwritten signature in black ink, appearing to read 'Omid Beik', written above a horizontal line.

Omid Beik, Ph.D.

Appendix A: CV of Omid Beik, Ph.D.

Omid Beik, Ph.D., SMIEEE
Assistant Professor (tenure-track)
Department of Electrical Engineering
Colorado School of Mines
1500 Illinois St., Golden, CO 80401 USA
Email: beik@mines.edu; URL: <https://www.epowerhubs.com>

A. Professional Appointments

8/2023 – Present	Assistant Professor (tenure-track)	Department of Electrical Engineering, Colorado School of Mines, Golden, CO 80401 USA
10/2021 – 07/2023	Assistant Professor (tenure-track)	Department of Electrical and Computer Engineering, North Dakota State University, Fargo, ND 58102 USA
06/2019 – 09/2021	Founder & Director	Enercs Inc. (Early-stage start-up) 2900 Highway 7, Vaughan, ON L4K 0G3 Canada
03/2020 – 04/2021	Senior R&D Manager	Forte Mobility Co. Ltd. 455 Magna Drive, Aurora, ON L4G 7A9 Canada
06/2018 – 04/2019	Lead R&D Engineer	Mirus International Inc. 31 Sun Pac Blvd, Brampton, ON, L6S 5P6 Canada
03/2017 – 01/2018	Senior Engineer	Magna Powertrain Inc. 800 Tesma Way, Concord, ON, L4K 5C2 Canada

B. Education

04/2016 – 04/2017	Postdoctoral Research Fellow	Department of Electrical and Computer Engineering, McMaster University, Hamilton, ON, L8S 4K1 Canada
01/2013 – 04/2016	Ph.D.	Department of Electrical and Computer Engineering, McMaster University, Hamilton, ON, L8S 4K1 Canada
09/2011 – 12/2012	Ph.D. Student	Power Conversion Group, School of Electrical and Electronic Engineering, The University of Manchester, UK
09/2007 – 10/2009	M.Sc. (Ranked 1 st in the Class)	Department of Electrical Engineering, Shahid Beheshti University, Abbaspour School of Engineering, Tehran, Iran
09/2003 – 07/2007	B.Sc. (Ranked 1 st in the Class)	Department of Electrical and Electronics Engineering, Yazd University, Yazd, Iran

C. Journal Editorial Experience

09/2023 – 07/2024: Guest Editor, MDPI Sustainability Special Issue: Sustainable Wind Power Systems: Recent Advancements in AC/DC Collector Grids, and High-Voltage DC (HVDC) and Low-Frequency AC (LFAC) Transmission Systems.

09/2023 – 04/2024: Guest Editor, MDPI Electronics, Special Issue: Recent Advances and Applications in Electric Machines Design, Modelling, Control, and Operation.

12/2020 – Present: Editor, IEEE Transactions on Energy Conversion.

12/2020 – Present: Editor, IEEE Power Engineering Letters.

07/2020 – 07/2022: Associate Editor, IEEE Transactions on Transportation Electrification.

07/2020 – 07/2022: Associate Editor, IEEE Transportation Electrification eNewsletter.

D. Conferences Professional Volunteering

04/2026: Technical Program Chair, IEEE Green Technologies (GreenTech) Conference

11/2024: Technical Track Chair, Annual Conference of the IEEE Industrial Electronics Society (IECON)

10/2023 – 11/2023: Conference Program Committee Member, IEEE Energy Conversion Congress and Exposition (ECCE), Nashville, TN, US.
 10/2022: Session Chair, IEEE Energy Conversion Congress and Exposition (ECCE), Detroit, MI, US.
 03/2023: Panel Reviewer for Department of Energy (DOE), US.
 08/2022: Panel Reviewer for Department of Energy (DOE), US.
 01/2022 – 12/2022: Conference Advisory Committee (CONAC) Member, IEEE Canada.
 05/2021: Session Chair, IEEE International Electric Machines & Drives (IEMDC), Virtual Event.
 06/2018: Panel Moderator, IEEE Transportation Electrification Conference and Expo (ITEC), Long Beach, CA, US.
 06/2017: Panel Organizer, IEEE Transportation Electrification Conference and Expo (ITEC), Chicago, IL, US.
 06/2016: Session Chair, IEEE Transportation Electrification Conference and Expo (ITEC), Dearborn, MI, US.

E. Service

09/2023 – Present: Undergraduate Committee, Colorado School of Mines, Golden, CO, US.
 2022 – 2023: Search Committee Member, Associate Vice President for Research and Faculty Development, North Dakota State University, Fargo, ND, USA.
 2022 – 2023: Research & Graduate Committee, College of Engineering, North Dakota State University, Fargo, ND, USA.
 09/2021 – 08/2023: Doctoral Dissertation Fellowship Review Committee, Department of Electrical and Computer Engineering, North Dakota State University, Fargo, ND, USA.

F. Publications

For a complete list of publications please visit [Google Scholar](https://scholar.google.com/citations?user=OmidBeik).

Patents

- [1] **Omid Beik**, “Electric Powered Landing Gear System,” United States Patent and Trademark Office (USPTO), US20210094517A1, Granted, Jun. 2022.
- [2] **Omid Beik**, “Electrified Landing Gear Adaptor,” United States Patent and Trademark Office (USPTO), US20200377062A1, Granted, Jun. 2022.
- [3] **Omid Beik**, “Electric Powered Landing Gear System,” European Patent Office (EPO), EP3798070B1, Granted, Mar. 2022.
- [4] **Omid Beik**, “Electric Powered Landing Gear System,” Canadian Intellectual Property Office (CIPO), CA3094627A1, Pending, Jul. 2022.

Books authored/co-authored (Published)

- [1] Mukund R. Patel, **Omid Beik**, “Spacecraft Power Systems,” 2nd edition, CRC Press, 2024.
- [2] Mukund R. Patel, **Omid Beik**, “Wind and Solar Power Systems: Design, Analysis, and Operation,” 3rd edition, CRC Press, 2021.
- [3] Ahmad S. Al-Adsani, **Omid Beik**, “Multiphase Hybrid Electric Machines: Applications for Electrified Powertrains,” Springer, 2021.
- [4] **Omid Beik**, Ahmad S. Al-Adsani, “DC Wind Generation Systems: Design, Analysis and Multiphase Turbine Technology,” Springer, 2020.

Journal Papers (Published)

- [1] M. Gholamian and **O. Beik**, “Coordinate Control of Wind Turbines in a Medium Voltage DC Grid,” IEEE Transactions on Industry Applications, early access, 2023.
- [2] B. Saude, N. LaSart, J. Blair and **Omid Beik**, “Microgrid-Based Wind and Solar Power Generation on Moon and Mars,” IEEE Transactions on Smart Grid, early access, 2022.
- [3] **Omid Beik**, Ahmad S. Al-Adsani, “A Wind Turbine Generator Design and Optimization for DC Collector Grids,” IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 10, no. 1, pp. 484-493, Feb. 2022.

- [4] **Omid Beik**, Ahmad S. Al-Adsani, "Active and Passive Control of a Dual Rotor Wind Turbine Generator for DC Grids," IEEE Access, vol. 9, pp. 1987-1995, 2021.
- [5] Ahmad S. Al-Adsani, Michel E. AlSharidah, **Omid Beik**, "BLDC Motor Drives: A Single Hall Sensor Method and a 160° Commutation Strategy," IEEE Transactions on Energy Conversion, vol. 36, no. 3, pp. 2025-2035, Sept. 2021.
- [6] **Omid Beik**, Ahmad S. Al-Adsani, "Wind Turbine Multiphase Operational Trajectory in an All DC Wind Generation System," IET Renewable Power Generation, vol. 14, issue 15, pp. 2916 – 2923, Nov. 2020.
- [7] **Omid Beik**, Ahmad S. Al-Adsani, "Parallel Nine-Phase Generator Control in a Medium Voltage DC Wind System," IEEE Transactions on Industrial Electronics, vol. 67, no. 10, pp. 8112-8122, Oct. 2020.
- [8] **Omid Beik**, "Design Optimization of a PM Motor: A Practical Approach for Mass Production," IEEE Transactions on Energy Conversion, vol. 35, no. 4, pp. 1849-1858, Dec. 2020.
- [9] **Omid Beik**, "Operational Envelope of an Electric Transmission Auxiliary System," IEEE Transactions on Energy Conversion, vol. 35, no. 3, pp. 1513-1521, Sept. 2020.
- [10] Apparao Dekka, **Omid Beik**, Mehdi Narimani, "Modulation and Voltage Balancing of a Five-Level Series-Connected Multilevel Inverter with Reduced Isolated DC Sources," IEEE Transactions on Industrial Electronics, vol. 67, no. 10, pp. 8219-8230, Oct. 2020.
- [11] Ahmad S. Al-Adsani, Ali Jurashi, **Omid Beik**, "ICE/HPM generator range extender for a series hybrid EV powertrain," IET Electrical Systems in Transportation, vol. 10, issue 1, pp. 96-104, Mar. 2020.
- [12] Ahmad S. Al-Adsani, **Omid Beik**, "Characterization of a Hybrid PM Generator Using a 32-Phase Brushless Excitation Scheme," IEEE Transactions on Energy Conversion, vol. 34, no. 3, pp. 1391-1400, Sept. 2019.
- [13] David Schumacher, **Omid Beik**, Ali Emadi, "Standalone Integrated Power Electronics System: Applications for Off-Grid Rural Locations" IEEE Electrification Magazine, vol. 6, no. 4, pp. 73-82, Dec. 2018.
- [14] Ahmad S. Al-Adsani, **Omid Beik**, "Design of a Multiphase Hybrid Permanent Magnet Generator for Series Hybrid EV" IEEE Transactions on Energy Conversion, vol. 33, no. 3, pp. 1499-1507, Sept. 2018.
- [15] **Omid Beik**, Nigel Schofield, "High-Voltage Hybrid Generator and Conversion System for Wind Turbine Applications" IEEE Transactions on Industrial Electronics, vol. 65, no. 4, pp. 3220-3229, April 2018.
- [16] **Omid Beik**, Ali Emadi, "Toward Integrated Digital Aircraft Control Systems: For Electrified-System Optimized Size, Cost, and Efficiency" IEEE Electrification Magazine, vol. 5, no. 4, pp. 46-52, Dec. 2017.
- [17] **Omid Beik**, Nigel Schofield, "An Off-Shore Wind Generation Scheme with High Voltage Hybrid Generator, HVDC Interconnections and Transmission" IEEE Transactions on Power Delivery, vol. 31, no. 2, pp. 867-877, April 2016.
- [18] **Omid Beik**, M. R. Aghamohammadi, M. Rezaee "Generator Dynamic Performance Affected by Parameter's Uncertainty," American Journal of Applied Sciences, vol. 10, no. 6, pp. 570-578, June 2013.
- [19] **Omid Beik**, M. Hajati, M. R. Aghamohammadi, "An Analytical Method to Parameter Estimation by Dynamic Performance Evaluation" International Journal of Energy and Power, vol. 2, no. 1, Feb. 2013.
- [20] **Omid Beik**, V. Ghorbani, "Economic Evaluation of Optimal Location of FACTS Devices Using Genetic Algorithm for Voltage Drop Cost Reduction" Journal of Quarterly Energy Economics Review, vol. 5, no. 16, pp. 185-199, Spring 2008.

Conference Papers (Published)

- [1] M. Homaeinezhad, **O. Beik** and A. Karni, "Multiphase Multilevel NPC Converter for MVDC Electric Ship Applications," 2023 IEEE Electric Ship Technologies Symposium (ESTS), Alexandria, VA, USA, 2023, pp. 121-128.
- [2] M. Arshad, **O. Beik**, R. Pallapati and S. Hoberg, "Overview of Bison Wind Farm: An AC Collector and HVDC Transmission Grid," IEEE/IAS 59th Industrial and Commercial Power Systems Technical Conference (I&CPS), Las Vegas, NV, USA, 2023.
- [3] W. Ateeq and **O. Beik**, "Borrego Springs Microgrid Operation and Control: An Overview," IEEE/IAS 59th Industrial and Commercial Power Systems Technical Conference (I&CPS), Las Vegas, NV, USA, 2023.
- [4] **Omid Beik**, Mukund R. Patel, Sarah Talebzadeh, "Large Spacecraft Electric Propulsion Using Multiphase Generator," IEEE Aerospace Conference, Big Sky, MT, USA, Mar. 4-11, 2023.
- [5] Mahzad Gholamian, **Omid Beik**, "Coordinate Control of Wind Turbines in a Medium Voltage DC Grid" IEEE Energy Conversion Congress and Exposition (ECCE), Detroit, MI, USA, Oct. 09-13, 2022.

- [6] **Omid Beik**, Ahmad S. Al-Adsani, "Comparison of Active and Passive 9-Phase Wind Turbine Conversion System for an all DC Grid" IEEE Energy Conversion Congress and Exposition (ECCE), Vancouver, BC, Canada, Sept 10-14, 2021.
- [7] **Omid Beik**, Ahmad S. Al-Adsani, "Proposed Wind Turbine Limited- and High-Speed Operation," IEEE Electric Power and Energy Conference (EPEC), Edmonton, Canada, Nov. 2020.
- [8] **Omid Beik**, Ahmad S. Al-Adsani, "Wind Turbine Productivity and Wind Energy Assessment: An Ontario Case Study," IEEE Electric Power and Energy Conference (EPEC), Edmonton, Canada, Nov. 2020.
- [9] Ahmad S. Al-Adsani, **Omid Beik**, "Efficiency and Operational Envelop of a Hybrid PM Machine System for HEVs," The 10th IET International Conference on Power Electronics, Machines and Drives (PEMD), Nottingham, UK, April 2020.
- [10] **Omid Beik**, Rong Yang, Ali Emadi, "Design of a 5-Phase IPM Machine for Electric Vehicles" IEEE Transportation Electrification Conference and Expo (ITEC), Long Beach, CA, USA, pp. 168-172, 2018.
- [11] **Omid Beik**, Appao Dekka, Mehdi Narimani, "A New Modular Neutral Point Clamped Converter with Space Vector Modulation Control," IEEE International Conference on Industrial Technology (ICIT), Lyon, France, pp. 591-595, 2018.
- [12] Nigel Schofield, **Omid Beik**, "Wind Turbine High Voltage Generator and System," The 15th Wind Integration Workshop, Vienna, Austria, Nov. 15-17, 2016.
- [13] **Omid Beik**, Nigel Schofield, "High Voltage Generator for Wind Turbines" The 8th IET Conference on Power Electronics, Machines and Drives (PEMD 2016), Glasgow, Scotland, UK, April 19-21, 2016.
- [14] **Omid Beik**, Nigel Schofield, "Hybrid Generator for Wind Generation Systems" IEEE Energy Conversion Congress and Exposition (ECCE 2014), Pittsburgh, PA, USA, Sept 14-18, 2014.
- [15] **Omid Beik**, Nigel Schofield, Ahmad S. Al-Adsani, "Variable Speed Brushless Hybrid Permanent Magnet Generator for Hybrid Electric Vehicles" IEEE Transportation Electrification Conference and Expo (ITEC), Michigan, USA, June 15-18, 2014.
- [16] Nigel Schofield, Xin Niu, **Omid Beik**, "Multiphase Machines for Electric Vehicle Traction" IEEE Transportation Electrification Conference and Expo (ITEC), Michigan, USA, June 15-18, 2014.
- [17] **Omid Beik**, Nigel Schofield, "A Brushless Exciter Design for a Hybrid Permanent Magnet Generator Applied to Series Hybrid Electric Vehicles" The 7th IET international conference on Power Electronics, Machines and Drives (PEMD), Manchester, UK, April 8-10, 2014.
- [18] **Omid Beik**, A. Salem Nia, "Damping of Power System oscillations in Multi-machine Power Systems Using Coordinate Design of PSS and TCSC" IEEE Environment and Electrical Engineering International Conference (EEEIC), Italy, May 8-11, p.1-4, 2011.
- [19] M. R. Aghamohammadi, **Omid Beik**, "Small Signal Stability Constrained Rescheduling Using Sensitivities Analysis by Neural Network as a Preventive Tool" IEEE Transmission and Distribution (T&D) 2010, New Orleans, Louisiana, USA, April 19-22, pp. 1-5, 2010.
- [20] M. R. Aghamohammadi, **Omid Beik**, M. Rezaee "Effect of Generator Parameters Inaccuracy on Transient Stability Performance" IEEE Asia-Pacific Power and Energy Conference (APPEEC) 2010, Chengdu, China, March 28-31, pp.1-5, 2010.
- [21] A. Salem Nia, **Omid Beik**, "Impact of TCSC reliability model on HLII reliability indices of power system" Proceedings of the 9th World Scientific and Engineering Academy and Society (WSEAS) International Conference on Power Systems, Budapest, September 3-5, pp. 117-122, 2009.

Appendix B: Table of Exhibits

Exhibit	Description
1001	U.S. Patent No. 11,349,291 to Smith et al.
1002	Declaration of Dr. Beik and CV.
1003	Reserved
1004	U.S. Patent Publication No. 2010/0139731 to Almy (“Almy”).
1005	Reserved
1006	CAB Hooks, Hangers & Mine Safety Products Catalog, 2010 (“CAB Catalog”).
1007	Underwriters Laboratories, “Safety Requirements for Wiring Systems and Connectors for Photovoltaic Systems,” 1984.
1008	SnakeTray, “Solar Snake Tray Announces New Cable Tray That Attached to Messenger Wire Rope for Solar Installations,” 2012, available at https://www.snaketray.com/solar-snake-tray-announces-new-cable-tray-that-attaches-to-messenger-wire-rope-for-solar-installations/ .
1009	National Fire Protection Association, “The National Electrical Code,” 2008 Edition.
1010	Department of the Army, the Navy, and the Air Force, “Technical Manual, Facilities Engineering, Electrical Exterior Facilities,” 1996.
1011	SolarPro Magazine, “PV Array Wire Management,” 2013.
1012	U.S. Patent No. 1,841,479 to Jessen.
1013	U.S. Patent No. 2,820,083 to Hendrix.
1014	Windpower Engineering, “Cable Spacers Solve Problem of Many Cables and Not Much Pole Space,” 2012, available at https://www.windpowerengineering.com/cable-spacers-solve-problem-of-many-cables-and-not-much-pole-space/ .
1015	File History of U.S. Patent No. 11,349,291.
1016	Reserved
1017	Reserved
1018	Jung, et al., “An In-depth Analysis for Optimal Cable Tray Support Span,” Sustainable Marine Structures, Volume 02, Issue 01, January 2020.
1019	IEEE Green Book 142, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems, 2007.
1020	IEEE, National Electrical Safety Code Committee, Accredited Standards Committee C2, Interpretation, Rule 235G, 2002.

1021	Advanced Cable Ties, Inc., “Cable Tie ‘Type’ Classifications.”
1022	IEEE Std 525-2007, “IEEE Guide for the Design and Installation of Cable Systems in Substations,” 2007.
1023	IEEE Std 1185-2010, “IEEE Recommended Practice for Cable Installation in Generating Stations and Industrial Facilities,” 2011.
1024	CAB Catalogs Web Page March 14, 2011, Internet Archive, https://web.archive.org/web/20110314084628/http://www.cabproducts.com/web_content.php?LookupID=catalogs .