UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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VOLTAGE, LLC

Petitioner,

v.

SHOALS TECHNOLOGIES GROUP, LLC

Patent Owner

_____

Post-Grant Review PGR202400022,

Declaration of Thomas W. Kenny in Support of the

Petition for Post-Grant Review of U.S. Patent No. 11,689,153

Voltage, LLC
EX1003-1

DECLARATION OF DR. THOMAS W. KENNY

[1] I currently hold the opinions expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

[2] I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

Dated: March 27, 2024

By: 

Thomas W. Kenny, Ph.D.

QUALIFICATIONS AND BACKGROUND INFORMATION

[3] My education and experience are described more fully in my curriculum vitae provided as Exhibit 1004. For ease of reference, I have highlighted certain information below.

[4] My academic and professional background is in Physics, Mechanical Engineering, Sensing, and Robotics, with a research specialization focused on microfabricated physical sensors, and I have been working in those fields since the completion of my Ph.D. more than 30 years ago. The details of my background and education and a listing of all publications I have authored in the past 35 years are provided in my curriculum vitae, attached as Appendix A. Below I provide a short summary of my education and experience which I believe to be most pertinent to the opinions that I express here.

[5] I received a B.S. in Physics from University of Minnesota, Minneapolis in 1983, and a Ph.D. in Physics from University of California at Berkeley in 1989. I was educated as a Physicist specializing in the design and fabrication of sensors to be used for measurements of many kinds. My Physics Ph.D. thesis involved measurements of the heat capacity of monolayers of atoms on surfaces and relied on precision measurements of temperature and power using time-varying electrical signals, and also on the design and construction of miniature sensor components and associated electrical circuits for conditioning and

conversion to digital format.

[6] My training in Physics at the University of Minnesota and at UC Berkeley relied on understanding of fundamental principles of electromagnetism, which include detailed study of the basic principles of electrical conduction, and the properties of resistors, capacitors, inductors, diodes, fuses, and many other semiconductor devices, including the basic properties of thermovoltaic devices and photovoltaic devices, and the ongoing research to optimize the band structures and other materials properties for more efficient conversion of thermal and optical energy to electrical energy. The basic electrical properties of cables and connectors are part of this training, including an understanding of the special requirements for systems that produce and carry large currents.

[7] After completion of my Ph.D. in Physics at U.C. Berkeley in 1989, I joined the Jet Propulsion Laboratory (JPL) in Pasadena, CA, as a staff scientist, and began working on miniature sensors and instruments for small spacecraft. This work involved the use of silicon microfabrication technologies for miniaturization of the sensors and served as my introduction to the field of micro-electromechanical systems (MEMS), or the study of very small mechanical sensors powered by electricity and used for detection of physical and chemical signals.

[8] While at JPL, we developed accelerometers, uncooled infrared sensors,

magnetometers, seismometers, force and displacement sensors, soil chemistry sensors, miniature structures for trapping interstellar dust, and many other miniature devices. Some of these projects led to devices that were launched with spacecraft headed for Mars and for other interplanetary missions. Much of this work involved the use of physical sensors for detection of small forces and displacements using micromechanical sensors. In many cases, the design of the sensors included considerations for packaging of the sensor to protect from external environments, and for management of electrical connections to the sensor. In this regard, my work at JPL involved the same two fundamental concepts behind the '153 Patent: (1) electrical connections and (2) molding to protect the electrical connections from environmental factors.

[9] I am presently the Richard Weiland Professor at the Department of Mechanical Engineering at Stanford University, where I have taught for the past 30 years. I am also currently the Senior Associate Dean of Engineering for Education and Student Affairs at Stanford.

[10] For almost all of these 30 years, I have taught courses in the Mechanical Engineering department at Stanford University on Sensors and Mechatronics. The annual enrollment in these collections of courses has exceeded 100 students for most of this time, and so I have had the privilege of teaching thousands of Stanford undergraduate students and graduate students in these topics. Of

course, teaching is a great way to learn, so my education in these topics includes approximately 40 years of learning, first as a student and then as an educator.

[11] The ME210 course titled "Introduction to Mechatronics" is a review of the mechanical, electrical, and computing technologies necessary to build electromechanical systems. The applications of this course include everything from cars and robots to cellphones and other consumer electronics devices. Alumni of this course are currently working at Apple, Tesla, Google, Meta, SpaceX, Intel, Bosch, Waymo, and many other large and small enterprises. A significant part of this course focuses on the design and implementation of power systems for mobile robots which includes batteries, regulators, protection diodes, fuses, and wiring harnesses. I was one of the instructors for the first offering of this course in 1995, and this course has been offered at least once each year ever since, except for the pandemic year of 2021. Students from this class include undergraduates with majors in Mechanical Engineering, Electrical Engineering, Computer Science, and other disciplines, and we also have representation of MS and PhD students from all these departments as well. Over the history of this course, as many as 2,000 students in this course have subsequently earned a B.S., M.S., or Ph.D. degree in electrical engineering, mechanical engineering, or an equivalent such as applied physics or general

engineering, and many of the students in this course enter with two or more years of professional experience relating to the design and/or manufacturing of electromechanical systems that include electrical wiring and connectors.

[12] I am the co-author of a textbook titled "Introduction to Mechatronic Design," which is used for the ME210 course described above. This textbook broadly covers the topic of integration of mechanical, electronic and computer systems design into "smart products." This textbook includes chapters on Voltage Regulators, Power Supplies and on Batteries, Noise, Isolation and Grounding, which includes discussion of design and construction of wiring harnesses that connect power sources to electronic systems, including microprocessors, diodes, fuses, and other elements.

[13] The ME220 course titled "Introduction to Sensors" is a broad overview of all sensing technologies, from thermometers to inertial sensors, ultrasound devices, flow sensors, optical and IR sensors, chemical sensors, pressure sensors, and many others. This course is focused on sensors that operate based on determination of changes in capacitance, resistance, piezoelectricity that arise from external signals. This course specifically includes discussion of the relation between sensor performance and environmental stresses, such as temperature, moisture, chemical corrosives, and mechanical strain. I first taught this course at Stanford in the Spring of 1994, and I offered this course at

least annually until 2016, when my duties as Senior Associate Dean made this impractical, yet have continued to offer this course periodically since, including these last two years.

[14] My research group at Stanford has focused on the area of microsensors and microfabrication—a domain in which we design and build micromechanical sensors using silicon microfabrication technologies. The various applications for these technologies are numerous.

[15] I have advised 75 Ph.D. students that have completed Ph.D. degrees and many more M.S. and B.S. students in Engineering during my time at Stanford.

[16] I have published over 250 technical papers in refereed journals and conferences in the field of sensors, MEMS, and measurements. I have further presented numerous conference abstracts, posters, and talks in my field. I am a named inventor on 50 patents in my area of work.

[17] From 2006 to 2010, I served as a program manager at DARPA in the Microelectronics Technology Office. I launched and managed programs in Thermal Management of High-Power Systems, Nanofabrication, and other areas. The Thermal Management Programs were focused on systems, such as the THAAD radar systems currently deployed around the world for missile defense, which required design and development of complex, systems that relied on delivery of huge amounts of electrical power to a compact radar

module, followed by extraction of huge amounts of thermal power in order to keep the radar systems operating within allowed temperatures. At a basic level, these systems required cables, connectors, and other structures for delivery of significant current, extraction of significant return current, and the simultaneous removal of heat. The underlying systems included cables, connectors, junctions, and protective insulation layers – all similar to the structures discussed in the '153 Patent.

[18] I received the Office of the Secretary of Defense Award for Exceptional Public Service in 2010, the IEEE Sensors Council Technical Achievement Award in 2011, and was named Fellow of the ASME in 2014. I was awarded the 2018 IEEE Daniel Noble Award for Emerging Technologies. In 2022, I was elected to the National Academy of Engineering.

[19] I have been retained on behalf of Voltage, LLC to offer technical opinions relating to U.S. Patent No. 11,689,153 ("the '153 Patent") and prior art references relating to its subject matter. EX1001. I have reviewed the '153 Patent, which is a continuation of U.S. Patent No. 10,992,254 ("the '254 Patent"), and the prosecution history of both the '254 patent and the '153 Patent, which are drawn from the same provisional Patent Application No. 62/047,773 ("'773 Provisional"). *See* EX1002; EX1020; EX1021. The full prosecution history, starting from the '773 Provisional to the issuance of the

’254 Patent, followed by the prosecution of the ’153 Patent, is informative to understand the terms used in the claims of the ’153 Patent. *See*, EX1014.

[20] As will be discussed below, the ’153 Patent describes the cables, connectors, harnesses, and lead assemblies that gather current from solar panels and deliver this current to an inverter for conversion to useful electrical energy (i.e., conversion from DC to AC). The ’153 Patent does not cover any of the technology that is represented by the semiconductor devices within the solar panels that convert sunlight to electrical energy, and the ’153 Patent does not discuss the technology within the inverter that converts DC current from the solar panels to useful AC electrical power. The ’153 Patent only covers wire wiring assemblies, which entirely consist of cables, cable junctions, molding to protect the electrical junction points, and connectors.

[21] Based on my experience, education, and research, including extensive experience with teaching courses that include emphasis on the design and fabrication of power systems and wiring harnesses for integrated systems, I believe that I am qualified to offer opinions as to the knowledge and level of skill of one of ordinary skill in the art at the time of the invention of the ’153 Patent (which I further describe below). Based on my experiences, I have a well-informed understanding of the capabilities of a person of ordinary skill. Indeed, I have taught, participated in organizations, and worked closely with

many such people over the course of my career, including the thousands of students who were enrolled in courses that I have taught on these topics. Based on my knowledge, skill, and experience, I understand the capabilities of a person of ordinary skill.

[22] In addition to any materials cited in the present declaration, I have also reviewed the following references:

[23] U.S. Published Patent Application No. 2011/0209741 to Solon ("Solon741," EX1005)

[24] I understand that Solon741 is prior art under 35 U.S.C. §§ 102(a)(1) because it was published on 9/1/2011, before the earliest priority date of the '153 Patent. I understand that Solon741 was not identified to or considered by the Examiner who allowed the '153 Patent, even though Solon741 has the same single inventor as the '153 Patent.

[25] U.S. Patent No. 6,268,559 to Yamawaki ("Yamawaki," EX1006)

[26] I understand that Yamawaki is prior art under 35 U.S.C. §§ 102(a)(1) because it was published on 7/31/2001, long before the earliest priority date of the '153 Patent. I have been informed by counsel that Yamawaki was addressed in prosecution, and that the Examiner asserted Yamawaki against various claims including the independent claims, but that the assertions by the Examiner regarding Yamawaki were not overcome by Applicant. I discuss

further below the significance of Yamawaki in the prosecution history in understanding the scope of the claims of the ’153 Patent.

[27] “Solar Line – Photovoltaic Interconnections System – Helios,” Amphenol Industrial Solar Technologies (“Amphenol,” EX1007)

[28] I understand that Amphenol is prior art under AIA § 102(a) because it was published no later than November 30, 2012, more than one (1) year before the earliest possible priority date of the ’153 Patent. I have been informed by counsel that Amphenol was not submitted to or considered by the Examiner who allowed the ’153 Patent.

[29] Chinese Patent No. 2785100 to Shao et al. (“Shao,” EX1008)

[30] I understand that Shao is prior art under 35 U.S.C. §§ 102(a)(1) because it was published on 5/31/2006, before the earliest priority date of the ’153 Patent. I have been informed by counsel that Shao was not identified to or considered by the Examiner who allowed the ’153 Patent.

[31] Japanese Patent No. 4080663 to Tamura (“Tamura,” EX1009)

[32] I understand that Tamura is prior art under 35 U.S.C. §§ 102(a)(1) because it was published on 4/23/2008, before the earliest priority date of the ’153 Patent. I have been informed by counsel that Tamura was not identified to or considered by the Examiner who allowed the ’153 Patent.

[33] U.S. Published Patent Application No. 2011/0011642 to Solon

("Solon642," EX1016)

[34] I understand that Solon642 is prior art under 35 U.S.C. §§ 102(a)(1) because it was published on 1/20/2011, before the earliest priority date of the '153 Patent. I have been informed by counsel that Solon642 was addressed in prosecution, and that the Examiner asserted Solon642 as a secondary reference against dependent claim 4, which related to an attachment aperture. I am not addressing dependent claim 4 in my Declaration and based on my review of the intrinsic record, the attachment aperture of dependent claim 4 is different than the "apertures" recited in the independent claims of the '153 Patent that I discuss further herein.

[35] In the prosecution of the '153 Patent, the Examiner considered prior art references that are specifically associated with solar power generation, as well as references that have nothing at all to do with solar power generation. On the face of the '153 Patent, there is a customary presentation of the 'Field of Classification Search,' which includes classifications that relate to solar power (generally, the H01L fields), as well as classifications that are associated with cables, connections, and packaging of cables (generally, the H01R fields). Therefore, the Examiner for the '153 Patent believed it to be appropriate to consider prior art examples from outside of the solar power generation category. In particular, U.S. Patent No. 3,852,516 to Vander Ploog, which was

considered along with U.S. Patent No. 6,268,599 to Yamawaki, as grounds for rejecting proposed claims of the ’153 Patent, relates to power distribution (even though Yamawaki is not listed on the face of the ’153 Patent).

[36] To further corroborate that a person of ordinary skill in the art (POSITA) would possess the foundational knowledge of employing cables and connectors for electrical connections across various applications to combine and distribute electric current before the earliest priority date of the '153 patent, I have cited two books. First, the National Electrical Code (“NEC 2002,” EX1010) teaches how to determine design details, including acceptable gauges of cable, electrical connector designs and wiring harness requirements. Second, “Photovoltaic System Engineering, Third Edition,” (“PSE textbook,” EX1011), which teaches the basic information and engineering considerations for designing a wide range of solar power installations. The PSE textbook restates basic engineering concepts used in combining and distributing electric current using cable assemblies or wire harnesses that I have used repeatedly in my decades of teaching engineering courses. Also, the PSE textbook refers to the NEC 2002. *see* EX1011, *e.g.,* p.86. I have also reviewed various supporting references and other documentation as further noted in my opinions below.

[37] Counsel has informed me that I should consider these materials through the lens of one of ordinary skill in the art related to the ’153 Patent at the time of

the earliest possible priority date of the ’153 Patent, and I have done so during my review of these materials. The ’153 Patent claims the benefit of priority to a provisional application filed 9/9/2014, which I understand from Counsel is referred to as “the Critical Date”. Counsel has informed me that the Critical Date represents the earliest possible priority date to which the challenged claims of the ’153 Patent are entitled, and I have therefore used that Critical Date in my analysis below.

[38] I have no financial interest in the parties or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

[39] In writing this declaration, I have considered the following: my own knowledge and experience, including my work experience in the fields of mechanical engineering, computer science, and electrical engineering; my experience in teaching those subjects; and my experience in working with others involved in those fields. In addition, I have analyzed various publications and materials, in addition to other materials I cite in my declaration.

[40] My opinions, as explained below, are based on my education, experience, and expertise in the fields relating to the ’153 Patent. Unless otherwise stated,

my testimony below refers to the knowledge of one of ordinary skill in the art as of the Critical Date, or before. Any figures that appear within this document have been prepared with the assistance of Counsel and reflect my understanding of the '153 Patent and the prior art discussed below.

OVERVIEW OF CONCLUSIONS FORMED

[41] This declaration explains the conclusions and opinions that I have formed, based on my analysis. To summarize those conclusions, based upon my knowledge and experience and my review of the prior art publications listed above, I conclude the following.

[42] Claims 1, 5-7, 11-14, 16, 17, and 21-24 are obvious and therefore unpatentable under 35 U.S.C. § 103 based on the disclosures in Solon741 and Yamawaki.

[43] Claims 1-3, 5-19, and 21-24 are obvious and therefore unpatentable under 35 U.S.C. § 103 based on the disclosures in Amphenol, Shao, and Yamawaki.

[44] Claim 20 is obvious and therefore unpatentable under AIA 35 U.S.C. § 103 based on the disclosures in Amphenol, Shao, Yamawaki, and further in view of Tamura.

[45] Claims 1-3, 5, 8-11, 13, 15-23, and 24 are obvious and therefore unpatentable under AIA 35 U.S.C. § 103 based on the disclosures in Amphenol, Shao, and Tamura.

[46] Claims 1-3, 5-10, 12-15, 18, 19, and 21-24 are obvious and therefore unpatentable under AIA 35 U.S.C. § 103 based on the disclosures in Yamawaki and Shao.

[47] Claims 11, 16, and 17 are obvious and therefore unpatentable under AIA 35 U.S.C. § 103 based on the disclosures in Yamawaki, Shao, and Solon741.

[48] Claim 20 is obvious and therefore unpatentable under AIA 35 U.S.C. § 103 based on the disclosures in Yamawaki, Shao, and Tamura.

[49] Claims 1-24 are invalid as indefinite under 35 U.S.C. §112 Grounds.

[50] The exhibits considered by me in preparing this declaration include:

EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 11,689,153 to Solon ("'153 Patent")
1002	Prosecution History of '153 Patent
1004	Curriculum Vitae of Thomas W. Kenny
1005	U.S. Published Patent Application No. 2011/0209741 to Solon ("Solon741")
1006	U.S. Patent No. 6,268,559 to Yamawaki ("Yamawaki")
1007	"Solar Line – Photovoltaic Interconnections System – Helios," Amphenol Industrial Solar Technologies ("Amphenol")
1008	Chinese Patent No. CN 2785100 to Shao et al. ("Shao") – Translation Certified
1009	Japanese Patent No. 4080663 to Tamura ("Tamura") – Translation

	Certified
1010	"National Electrical Code 2002," by National Fire Protection Association ("NEC 2002")
1011	"Photovoltaic System Engineering, Second Edition," ("PSE textbook")
1012	Chinese Patent No. CN 2785100 to Shao et al. ("Shao") – Original
1013	Japanese Patent No. 4080663 to Tamura ("Tamura") – Original
1014	'153 Patent priority Provisional Patent Application ("'773 Provisional")
1015	'153 Patent Continuation Application, Filing Receipt
1016	U.S. Published Patent Application No. 2011/0011642 to Solon ("Solon642")
1017	Order No. 16: In the Matter of CERTAIN PHOTOVOLTAIC CONNECTORS AND COMPONENTS THEREOF, Inv. No. 337-TA-1365, (Int'l Trade Comm., February 20, 2024).
1018	Shoals Technologies Group, LLC v. Voltage, LLC et al., Docket No. 1:23-cv-00365, Order on Motion to Stay, Dkt. 20 (M.D.N.C. June 28, 2023).
1019	Japanese Patent Application KOKAI Publication No. 7-131045 to Ito ("Ito") – Original
1020	U.S. Patent No. 10,992,254 to Solon ("'254 Patent")
1021	Prosecution History of '254 Patent
1022	Japanese Patent Application KOKAI Publication No. 7-131045 to Ito ("Ito") – Machine Translation

1023	U.S. Patent No. 3,852,516 to Vander Ploog, et al. ("Vander Ploog")
1024	Amphenol Declaration of Gary Joseph ("Joseph Decl.")

I. Statutory Grounds for Challenge

[51] Counsel has informed me that I should consider the following grounds:

[52] **GROUND 1**: Claims 1, 5-7, 11-14, 16, 17, and 21-24 are unpatentable under AIA 35 U.S.C. § 103 as obvious over Solon741 (EX1005) in view of Yamawaki (EX1006).

[53] **GROUND 2**: Claims 1-3, 5-19, and 21-24 are unpatentable under AIA 35 U.S.C. § 103 as obvious over Amphenol (EX1007) in view of Shao (EX1008) and further in view of Yamawaki (EX1006).

[54] **GROUND 3**: Claim 20 is unpatentable under AIA 35 U.S.C. § 103 as obvious over Amphenol (EX1007), Shao (EX1008), Yamawaki (EX1006), and further in view of Tamura (EX1009).

[55] **GROUND 4**: Claims 1-3, 5, 8-11, 13, 15-23, and 24 are unpatentable under AIA 35 U.S.C. § 103 as obvious over Amphenol (EX1007) in view of Shao (EX1008) and further in view of Tamura (EX1009).

[56] **GROUND 5**: Claims 1-3, 5-10, 12-15, 18, 19, and 21-24 are unpatentable under AIA 35 U.S.C. § 103 as obvious over Yamawaki (EX1006) in view of Shao (EX1008).

[57] **GROUND 6**: Claims 11, 16, and 17 are unpatentable under AIA 35 U.S.C. § 103 as obvious over Yamawaki (EX1006) in view of Shao (EX1008) and further in view of Solon741 (EX1005).

[58] **GROUND 7**: Claim 20 is unpatentable under AIA 35 U.S.C. § 103 as obvious over Yamawaki (EX1006) in view of Shao (EX1008) and further in view of Tamura (EX1009).

[59] **GROUND 8**: Claims 1-24 are unpatentable under 35 U.S.C. § 112 as being indefinite.

II. Level of Ordinary Skill in the Art

[60] I believe that a person of ordinary skill in the art (POSITA) would have a B.S. degree in electrical engineering, mechanical engineering, or an equivalent such as applied physics or general engineering, and two years of professional experience relating to the design and/or manufacturing of electrical wiring and connectors. Lack of professional experience can be remedied by additional education and related experience, and vice versa. The '153 Patent is focused on the cables, harnesses, assemblies, and connectors that bring power from solar panels to an inverter, all of which are based on very basic concepts around electrical connectors and molded protective layers.

[61] I understand that the patent owner has challenged my qualifications as an

expert for consideration of the ’153 Patent. In the parallel ITC proceedings, the patent owner has asserted that two years of experience with an understanding of Balance of Systems Components for utility-scale photovoltaic power installations is required. This is a substantial overstatement of the requirements for understanding of the ’153 Patent. The patent is not limited to utility-scale solar installation (such a limitation was disavowed by the patent owner during prosecution of the ’254 patent), and for which the specification, figures, and claims are focused on limitations that are associated with the connections between cables and with molded protection layers. I look forward to further discussions on this matter.

III. Prosecution History

[62] The application that issued as the ’153 Patent, No. 17/301,609 (“the ’153 Application”), was filed on 4/8/21. The ’153 patent is a continuation application that claims priority to U.S. Patent Application No. 14/849,458, filed 9/9/15, which claims priority to U.S. Provisional Application No. 62/047,773, filed 9/9/14. EX1001, Cover.

Prosecution History of the ’254 Patent, the Parent of the ’153 Patent

[63] U.S. Patent Application No. 14/849,458, issued on 4/27/21 as the ’254 Patent (“the ’254 Application”). EX1020, Cover. The prosecution history of

the ’254 Patent is important to understand the origin of some of the claim language used in the claims of the 153 Patent, because there otherwise is little to no written description support, as I discuss in Section H (Ground 8) of my declaration below.

[64] The original filed claim 1 in the ’254 Application was directed to a lead assembly for use in a solar energy installation including at least one drop line and one feeder cable electrically coupled at a nexus, a means for securing said nexus such a compression lug, and an overmold surrounding the compression lug. EX1021, p. 16. The entire claim is reproduced below:

1. A lead assembly for use in a solar energy installation including:

A. At least one drop line terminating in a drop line connector;

B. At least one feeder cable terminating in a feeder cable connector, said at least one drop line and said at least one feeder cable electrically coupled at a nexus;

C. A means for securing said nexus, said securing means selected from the group consisting of compression lug, soldering, splicing, crimping, and combinations thereof; and

D. An overmold surrounding said compression lug, wherein said lead assembly combines power from a plurality of solar arrays and transmits that power to an inverter in a solar energy installation lacking a combiner box between said solar arraysand said inverter.

[65] After several rejections and amendments, the applicant had amended proposed claim 1 in the ’254 Application on 12/11/19 to what is shown below. I note that new language previously added to the claim includes an “undermold

having an inner surface and an outer surface, said inner surface surrounding and fully encasing said securing means" and "an undermold-overmold interface". In the 12/11/19 amendment, the Applicant added the limitation "and is suitable for utility-scale installations." EX1021, p. 237.

1. (**Currently Amended**) A lead assembly for use in a solar energy installation including:

   A. A first drop line and a second drop line, said first drop line terminating in a drop line connector;

   B. At least one 30 amp feeder cable terminating in a feeder cable connector, said first drop line and said at least one feeder cable electrically coupled at a nexus;

   C. A means for securing said nexus, said securing means selected from the group consisting of compression lug, soldering, splicing, crimping, and combinations thereof;

   D. An undermold having an inner surface and an outer surface, said inner surface surrounding and fully encasing said securing means; and

   E. An overmold surrounding said undermold and forming an undermold-overmold interface only at said outer surface, wherein said lead assembly combines power from a plurality of solar arrays and transmits that power to an inverter in a solar energy installation lacking a combiner box between said solar arrays and said inverter, and wherein said lead assembly has a voltage rating of 1500 VDC **and is suitable for utility-scale installations**.

[66] On 4/22/2020, the Examiner, Eric Ryan Smith, sent e-mail correspondence to the prosecuting attorney with proposed amendments to the claims that would

bring the case into condition for allowance if accepted. EX1021, p. 286-287. The proposed amendment added 113 words to the "undermold" limitation, which included "aperture" structures and defining features of said apertures, such as the "first aperture concentric with said securing means", "first aperture extending continuously through said undermold in said longitudinal direction and having a first diameter", "second aperture concentric with said first drop line", "second aperture… parallel to said first aperture", "second aperture only partially extending through said undermold in said longitudinal direction" and "second aperture having a second diameter small than said first diameter." The proposed amendment in Examiner Smith's e-mail is re-produced and the "aperture" structures highlighted below:

D. An undermold having an inner surface and an outer surface, both surfaces extending in a longitudinal direction of said at least one feeder cable, said inner surface surrounding and fully encasing said securing means, said inner surface comprised of a first aperture concentric with said securing means and said at least one feeder cable, said first aperture extending continuously through said undermold in said longitudinal direction and having a first diameter, said at least one feeder cable continuously extending through said first aperture, and a second aperture concentric with said first drop line and parallel to said first aperture, said second aperture only partially extending through said undermold in said longitudinal direction, said second aperture having a second diameter smaller than said first diameter, said first drop line extending from said second aperture; and

[67] The proposed amendment also struck "and is suitable for utility scale installations." *Id.*

[68] On 5/8/2020, the prosecuting attorney responded to Mr. Smith's inquiry as to whether the Applicant would accept or deny the amendments that she "[r]eached out again and still not response" and that she "will wait for the

Office Action." *Id.*

[69] On 5/13/2020, Examiner Smith issued an office action with new rejections to the 12/19/2019 amendments. Notably, the Examiner found the claims indefinite under 35 U.S.C. § 112 as indefinite based on the added language "suitable for utility-scale installations." *Id.* at 273-274. "Further a skilled artisan would not inherently understand that the lead assembly of the disclosure is suitable for utility-scale installations, based on the disclosure as originally filed. Therefore, a skilled artisan would not understand that the inventor had possession of the claimed invention at the effective date of filing of the application." The Examiner further wrote: "Put another way, the examiner does not understand 'suitable for utility-scale installations' to be a commonly used term of the art with a definite meaning that clearly describes what is included and excluded by the phrase. Are some lead assemblies having a 30 amp feeder cable and voltage rating of 1500 VDC that are not suitable for utility-scale installations? If so, what structure is present in the claimed invention that differentiates it from such (hypothetical) lead assemblies? Would a lead assembly with a 20 amp feeder cable and 1000 VDC voltage rating be suitable for utility scale installations? Such distinctions cannot be determined from the disclosure as originally filed, and the claims are indefinite. *Id.*

[70] On 11/12/20, the prosecuting attorney filed a response to non-final office

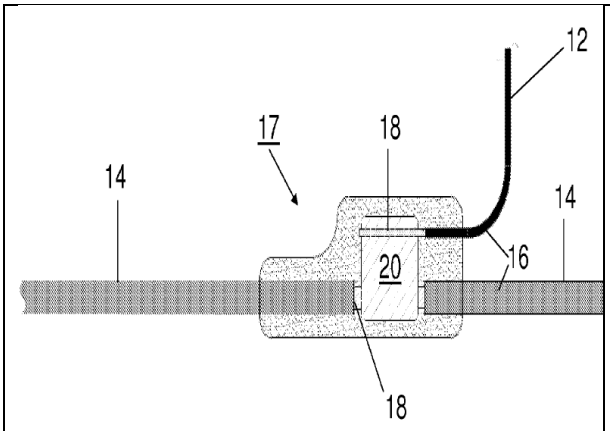
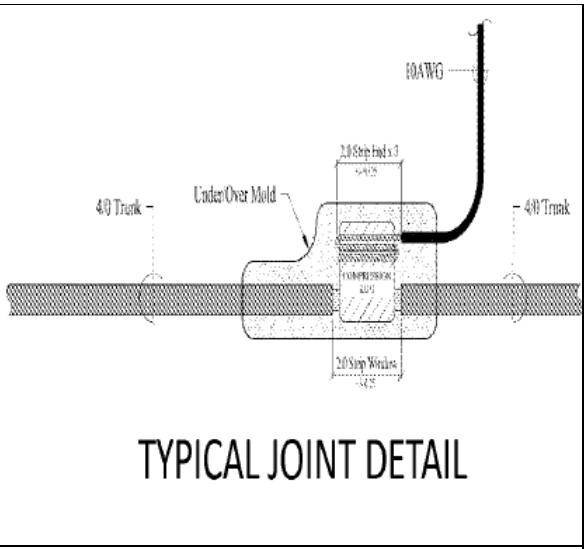
action adopting Examiner Smith's proposed amendments. EX1021, p. 297-301, 305. Thereafter, a notice of allowance was issued. EX1021, p. 311.

Prosecution History of the '153 Patent

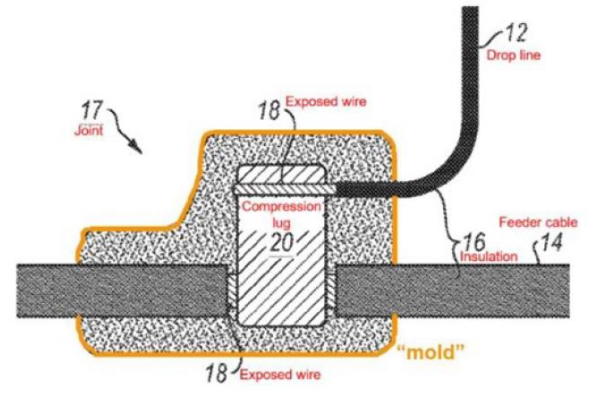
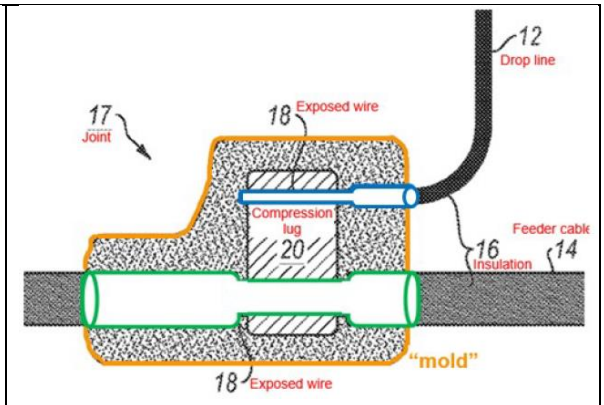
[71] On 4/8/21, Applicant filed the '153 Application, with originally filed claims that carried forward some of the aperture structure limitations that Examiner Smith placed into the claims to put them into condition for allowance, specifically the "undermold" structure further comprising "a first aperture extending completely through the undermold" and "a second aperture extending partially through the undermold". Below I have highlighted the relevant claim language from issued claim 1 of the '254 Patent carried forward into the original filed claim of the '153 Patent:

EX1020, claim 1 (issued on 4/23/21)	EX1002, p. 40 (originally filed claim 1 in '153 Application filed on 4/8/21)
1. A lead assembly for use in a solar energy installation including: A. A first drop line and a second drop line, said first drop line terminating in a drop line connector; B. At least one 30 amp feeder cable terminating in a feeder cable connector, said first drop line and said at least one feeder cable electrically coupled at a nexus; C. A means for securing said nexus, said securing means selected from the group consisting of compression lug, soldering, splicing, crimping, and combinations thereof; D. An undermold having an inner surface and an outer surface, both surfaces extending in a longitudinal direction of said at least one feeder cable, said inner surface surrounding and fully encasing said securing means, said inner surface comprised of a first aperture concentric with said securing means and said at least one feeder cable, said first aperture extending continuously through said undermold in said longitudinal direction and having a first diameter, said at least one feeder cable continuously extending through said first aperture, and a second aperture concentric with said first drop line and parallel to said first aperture, said second aperture only partially extending through said undermold in said longitudinal direction, said second aperture having a second diameter smaller than said first diameter, said first drop line extending from said second aperture; and E. An overmold surrounding said undermold and forming an undermold-overmold interface only at said outer surface, wherein said lead assembly combines power from a plurality of solar arrays and transmits that power to an inverter in a solar energy installation lacking a combiner box between said solar arrays and said inverter, and wherein said lead assembly has a voltage rating of 1500 VDC.	1. A lead assembly for use in a solar energy installation including: a drop line; a feeder cable electrically coupled to the drop line at a nexus; an undermold that fully encases the nexus, the undermold further comprising: a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis; and a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis; and an overmold surrounding the undermold and forming an undermold-overmold interface at an outer surface of the undermold.

[72] The claim language appears to reflect the mold structure shown in Figure 7 of the specification and the "Typical Joint Detail" schematic from the '773 Provisional, both reproduced below, where a first aperture corresponding to the feeder cable extends completely through the mold structure and a second aperture corresponding to the drop line wire extends partially through the mold structure, ending at left edge of the compression lug 20.

	
EX1001, Figure 7	**EX1014, p. 23**

[73] An Annotated Figure 7 and demonstrative where the underlying cables are removed (to see the apertures in the mold structure) is shown below:

	
EX1001, Figure 7 (annotated)	**EX1001, Figure 7 (annotated) with underlying cables removed**

[74] The Applicant proposed dependent claim 10, "the lead assembly of claim 1, further comprising a third aperture extending partially through the undermold and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis".

[75] The ’153 Patent’s specification does not include any discussion of aperture structures within a mold and Figure 7 is the only figure illustrating a mold structure. I have included below one possible embodiment of dependent claim 10’s addition of a “third aperture extending partially through undermold” as applied to Figure 7 and another demonstrative where the underlying cables are removed so as to show the mold with its aperture structures:

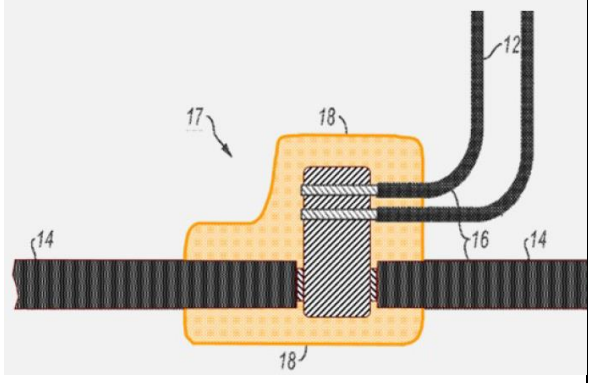


Figure 7 (applied to three apertures)

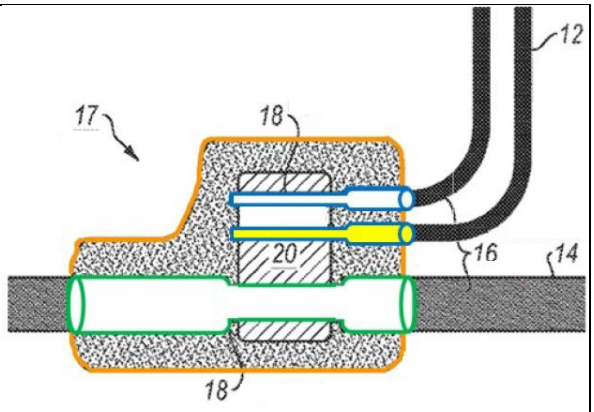


Figure 7 (annotated) with underlying cables removed

[76] Prosecution on the ’153 Patent began with a non-final Office Action that issued on 6/22/22; with claims 1-3, 8, and 9 rejected under 35 U.S.C. § 102(a)(1) as anticipated by U.S. Patent No. 3,852,516 to C Ploog et al. (“Vander Ploog”); claims 1, 4, 8, and 9 rejected under 35 U.S.C. § 102(a)(1) as anticipated by U.S. Patent No. 6,265,665 to Zahnen (“Zahnen”); claims 1-3, 5-9, 13-16, 18, and 19 rejected under 35 U.S.C. § 103 as unpatentable over U.S. Patent No. 6,268,559 to Yamawaki (“Yamawaki”) and Vander Ploog; claim 4

rejected under 35 U.S.C. § 103 as unpatentable over Yamawaki, Vander Ploog, and U.S. Patent Application No. 2011/0011642 to Solon ("Solon642"); claim 12 rejected under 35 U.S.C. § 103 as unpatentable over Ploog and U.S. Patent Application No. 2010/0139733 to Jonczyk et al. ("Jonczyk"); claim 10 rejected under 35 U.S.C. § 103 as unpatentable over Zahnen and U.S. Patent Application No. 2009/0088032 to Keeven et al. ("Keeven"); claims 1-3, 5-8, 10, and 11 rejected under 35 U.S.C. § 103 as unpatentable over Japanese Patent Publication 2003-293536 to Umeoka ("Umeoka") and further in view of U.S. Patent Application No. 2012/0125395 to Bellacicco et al. ("Bellacicco"). See EX1002, pp.221-239.

[77] Proposed independent claim 16 recited a "solar power system" comprising a plurality of solar panels and a lead assembly comprising a "primary mold" with first and second apertures. Dependent claim 17 recited a "second drop line electrically connected to the feeder cable at a **second nexus** fully encased by the primary mold, wherein the second drop line extends into a third aperture defined by the primary mold along a third longitudinal axis." EX1002, p. 42 (emphasis added). Claim 17 was the only originally proposed claim deemed as having allowable subject matter. EX1002, p. 86.

[78] On 12/22/22, Applicant responded to the non-final Office Action by bringing dependent claim 17 into independent claim 16 as new independent

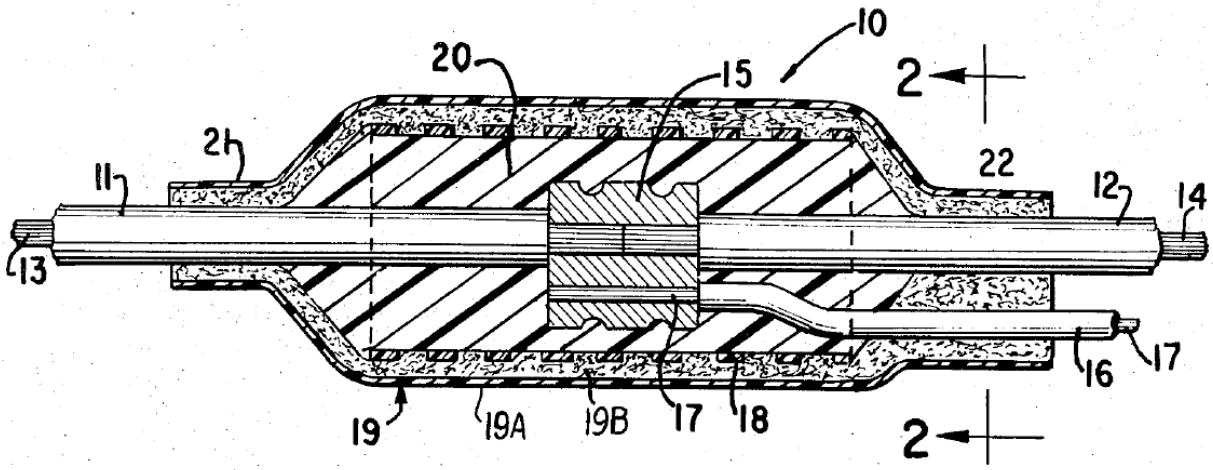
claim 20 and requested the claim be allowed. EX1002, p. 99, 102. Applicant also amended independent claim 1 to recite, in part "terminating at a drop line connector, the drop line connector configured to connect with a central trunk of a wire harness, the central trunk of the wire harness having a plurality of branches that each electrically connect to a separate solar panel contained in an array of a plurality of solar panels", and amending independent claim 16 to recite, in part "a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness...a drop line electrically connected to a central trunk of the wire harness". *Id.,* pp.106-114.

[79] In the Final Office Action, dated 3/03/23, claims 1-12 and 15-20 were rejected, claim 20 is allowed, and claims 10, 11, and 17 were objected to being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. EX1002, p. 118-127. The Examiner noted that "the prior art does not teach or suggest a lead assembly having structure and function of claim 10, or a system having the structure and function of claim 17." EX1002, p. 126. In particular, claims 1-3, 5-9, 15, 16, 18, and 19 (including the language above) were rejected under 35 U.S.C. § 103 as unpatentable over Yamawaki and Vander Ploog. EX1002, p. 118-127.

[80] The Examiner's rejection is important because it found that Yamawaki

taught a lead assembly, a drop line terminating at a drop line connector, a feeder cable electrically coupled to the drop line at a nexus, an undermold that fully encases the nexus, and an overmold surrounding the undermold and forming an undermold-overmold interface at an outer surface of the undermold. EX1002, p. 118-120. The Examiner, however, found that "[t]he undermold 33e… is not specifically shown to have a first aperture and second aperture." EX1002, p. 120. The Examiner turns to Vander Ploog for the mold's aperture structure limitations. "The undermold of modified-Yamawaki would therefore possess the claimed first aperture and second aperture with the claimed properties." *Id.*

[81] Vander Ploog's mold structure, however, only shows a first aperture extending completely through and a second aperture extending partially through the undermold, as shown in FIG. 1 below:



EX1023, FIG. 1

[82] Vander Ploog was not found to teach a second drop line and third aperture

structure as recited in dependent claims 10 and 17.

[83] On 3/10/23, Applicant responded to the final Office Action by amending claim 1 to incorporate limitations from claim 10 and amended claim 16 to incorporate limitations from claim 17. EX1002, p. 140-144. Applicant argued that because "Office Action indicates that claims 10, 11 and 17 are directed to patentable subject matter" that rewriting them into independent claims should be allowed. EX1002, p. 145-146. Applicant also claimed that claim 20 needed to amended to correct an antecedent basis error" and changed "second nexus" to "said nexus." EX1002, p. 145. Additionally, Applicant introduced new dependent claims 21-28. EX1002, p. 146.

[84] Applicant did not rebut the citations of Yamawaki as teaching the first dropline, feeder cable, and overmold/undermold. EX1002, p. 119. Applicant also did not rebut the Examiner's assertions that (1) the claim language of claim 1 did not require a central trunk or a wiring harness and only required a drop line configured to connect to a drop line, or that (2) Yamawaki taught the limitation of a central trunk and wiring harness as required by claim 16. EX1002, p. 127. Applicant also did not rebut Examiner's assertions that the aperture structures in the mold are the material displaced by the cable that form them ("the material of 20 displaced by the cable 12 is in the form of an aperture"; "the material of 20 displaced by line 16 is in the form of an

aperture"). EX1002, p. 124.

[85] A Notice of Allowability issued on 3/22/2023, in which the Examiner alleged that the prior art of record does "not reach or suggest a lead assembly or solar power system comprising a lead assembly with the limitations of claims 1, 16, and 20." EX1002, p. 153. On 6/27/2023 the application issued as the '153 Patent. EX1001, cover.

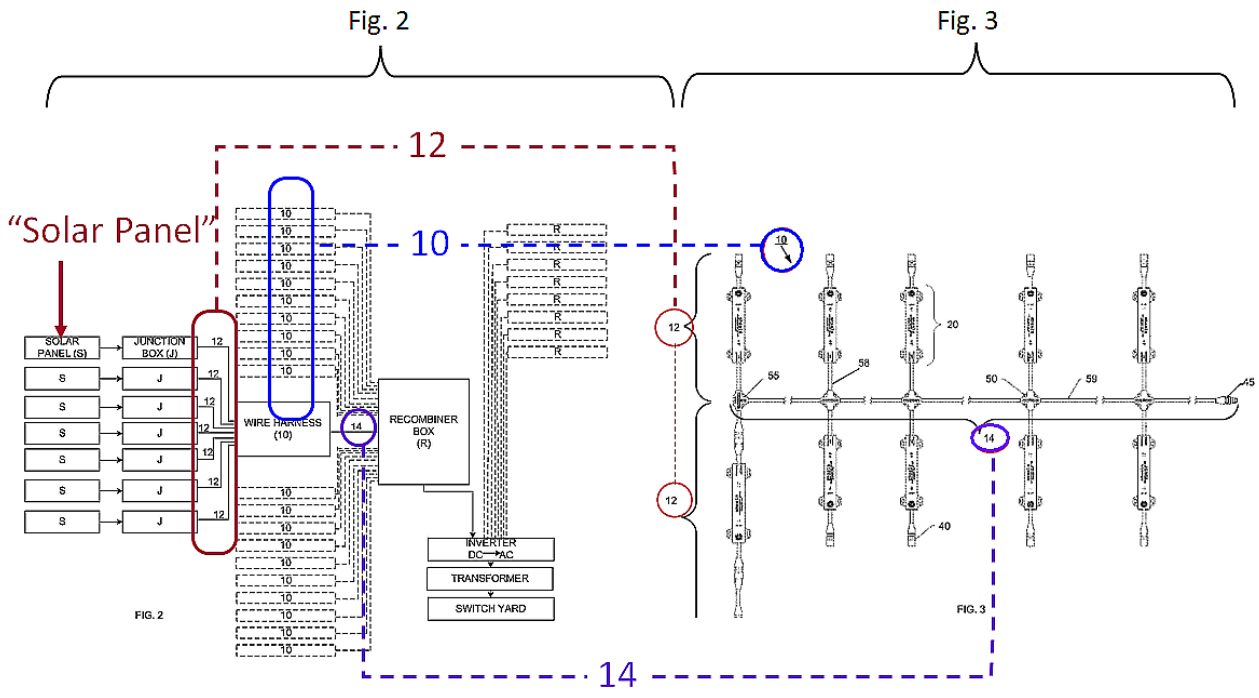
IV. Grounds of Rejection

A. Ground 1: Claims 1, 5-7, 11-14, 16, 17, and 21-24 are unpatentable under 35 U.S.C. § 103 as obvious over Solon741 in view of Yamawaki.

i. Motivation to Combine Solon741 and Yamawaki

[86] A POSITA would have been motivated to combine the teachings of Solon741 with those of Yamawaki (i.e., the "Solon741-Yamawaki combination") for the reasons set forth below.

[87] Solon741 discloses a "Solar Energy Wire Harness with In-Line Fuses." EX1005, Abstract. Solon741 is analogous prior-art to the '153 Patent because it is directed to solar power wiring assemblies with in-line fuses. *See id.*, Title and Abstract. Solon741 "relates generally to components used in the solar energy industry" and focuses on wire harnesses for solar applications. EX1005, ¶2. The combined figures below, from Solon741, shows a typical solar power system array. *See* EX1005, FIGS. 2 and 3 (combined with annotation).



EX1005, FIGS. 2 and 3 (combined with annotation)

[88] Solon741 also teaches including inline fuse holders in wire harnesses. In particular, Solon741 discloses that, "[t]he in-line fuse assembly may include a variety of fuse types, such as midget fuses and/or 1000V fuses." EX1005, ¶13. Further, Solon741 anticipates the need to protect each fuse from ambient conditions (i.e., the outdoor environment). *See id.*, ¶13. Of particular note is the wire gauge ranges are disclosed in Solon741 for branches or branch lines (e.g., drops or drop lines as claimed which are referred to as "branches"), namely "10 or 12 gauge photovoltaic wire." *Id.*, ¶29.

[89] In Solon741, the lead assemblies are referred to as wire harnesses. *See e.g., id.*, ¶26. Further below, in the analysis of the claims, I discuss how these terms are synonymous in this context. Both the lead assemblies and the wire

harnesses address the general problem of providing convenient, flexible, reliable, and low-cost wiring connections for solar cell installations. *See* EX1005, FIGS. 2 and 3 (combined with 1st-annotation), above. Also, in Solon741, the lead assemblies include a feeder cable, which is referred to as a "trunk," and "drops" or "drop lines" (as claimed), which are referred to as "branches." *See id*., ¶29. Solon741 uses this different terminology despite being directed to the same type of solar installations and naming the same inventor and owner. *See id*., cover. Therefore, as discussed below the '153 patent and the provisional of the '153 patent further explain away these differences in terminology from various elements of admitted prior-art. However, despite these acknowledged similarities and foundations of the '153 patent in the prior-art, Solon741, which is and was commonly assigned to the '153 patent, was not disclosed to the Examiner during prosecution.

[90] In the '153 Patent specification, which is focused on the lead assemblies, the wire harnesses are described as prior art with respect to the discussion of figures 1-4. Wire harnesses gather current from solar panels, and combine these currents at cable junctions to deliver the aggregate current on a "trunk cable." In the '153 Patent, these trunk cables are connected to drop lines of a lead assembly, which gathers current and combines these currents for delivery along a feeder cable to an inverter. The architecture of the wire harnesses and the

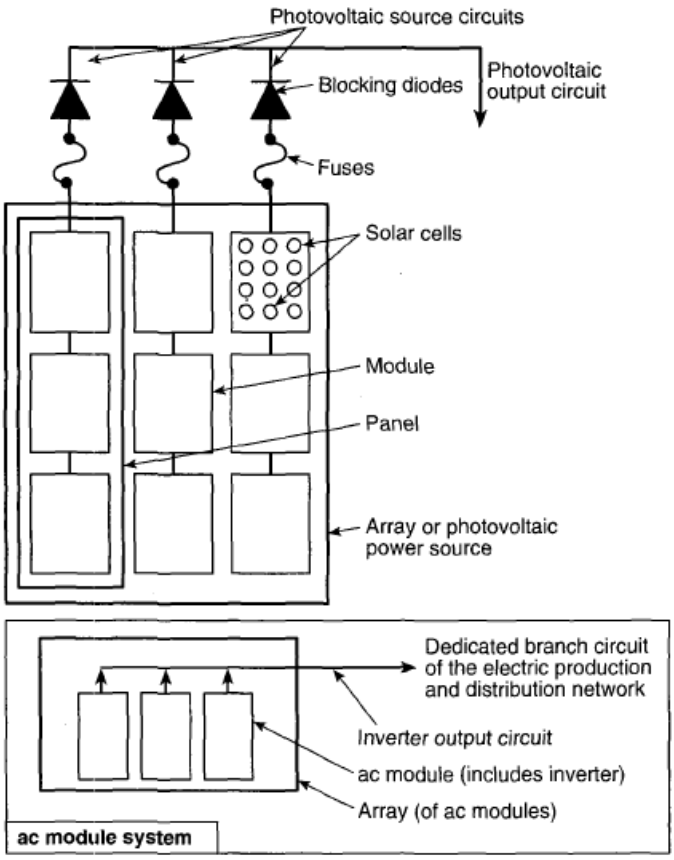
lead assemblies are the same, with the lead assemblies following the wire harnesses. The only significant difference is that the diameter of the cables in the lead assemblies are larger than in the wire harnesses, because of the larger currents present. Indeed, the '773'773 Provisional includes marketing literature from Shoals for its alleged commercial embodiment of the inventions disclosed in the '773'773 Provisional, specifically the "Big Lead Assembly Trunk Buss" or "BLA". EX 1014, p. 22. The '773'773 Provisional describes the Shoals BLA Trunk Buss as a "pre-manufactured harness" that "utilizes the same under/overmold construction currently deployed in the field today, but on a much larger scale." *Id.* The '773 Provisional continues to state that "[t]he same topology not only applies to the DC feeders, but can also be implemented into the feeders deployed in AC systems negating the need to AC Recombiners."

[91] The next page of the '773 Provisional illustrates at bottom a "Typical Joint Detail" which closely resembles Figure 7 of the '153 Patent. Above, the '773'773 Provisional depicts several "Joints" in series to one another along a trunk or DC feeder cable, labeled as "Typical Positive Harness" and "Typical Negative Harness."

[92] The next page of the '773 Provisional illustrates a "DC feeder "T" Joint" described as a "typical joint detail" with (1) a feeder cable and (2) a string harness or one leg of AC input. Based on Shoals' own marketing literature

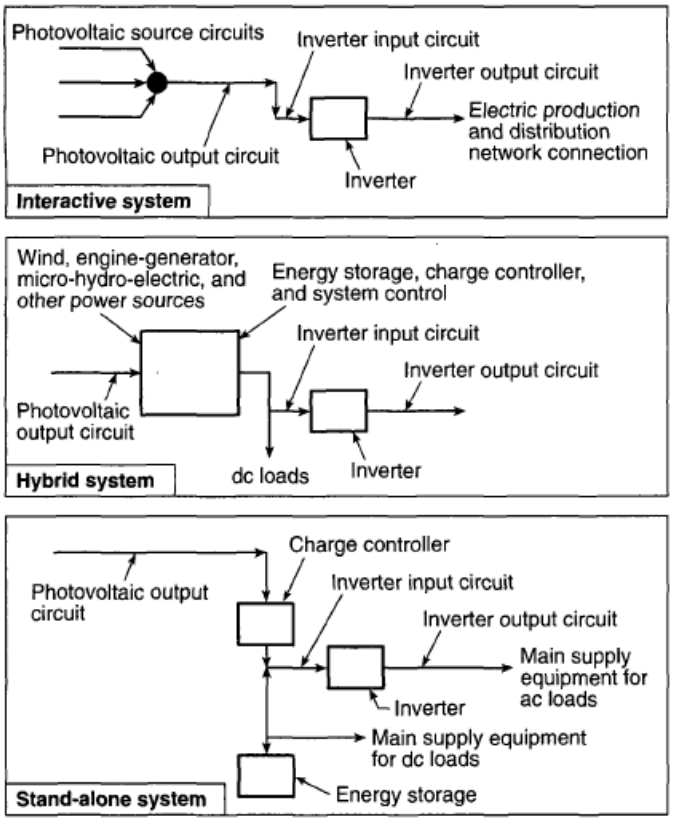
submitted in support of its provisional application, the '773 Provisional, it appears that Shoals referred to the cable assembly or "Joint" of the '153 Patent as a wire harness, but just "on a much larger scale."

[93] A POSITA would understand that a basic element of a solar power installation is what is referred to as the "photovoltaic source circuits," which includes all the interconnecting wiring that delivers power from a number of solar panels (i.e., modules) that generate power when exposed to sunlight to a common connection point, such as an inverter, as demonstrated by the National Electric Code (NEC) 2002 ("the NEC 2002"), Figures 690.1(A) and 690.1(B), reproduced below. *See* EX1010, p. 543-544. Some describe this group of elements that deliver power from solar panels to inverters as the "Electrical Balance of System" components, or EBOS, understanding that this is a category of cables, connectors, fuses, and assemblies that have been approved for use in solar installations. *See*, EX1011, p.128. A POSITA would understand that the photovoltaic source circuit includes one or more sets of wiring assemblies that complete a circuit and provide the structure for making connections from the individual solar panels and/or array of solar panels. These wiring assemblies are typically joined together at a common connection point, such as an inverter. *See id*.



Notes:
1. These diagrams are intended to be a means of identification for photovoltaic system components, circuits, and connections.
2. Disconnecting means required by Article 690, Part III are not shown.
3. System grounding and equipment grounding are not shown. See Article 690, Part V.

EX1010, Figure 690.1(A) Identification of solar photovoltaic system components



Notes:

1. These diagrams are intended to be a means of identification for photovoltaic system components, circuits, and connections.
2. Disconnecting means and overcurrent protection required by Article 690 are not shown.
3. System grounding and equipment grounding are not shown. See Article 690, Part V.
4. Custom designs occur in each configuration and some components are optional.

EX1010, Figure 690.1(B) Identification of solar photovoltaic system components in common system configurations

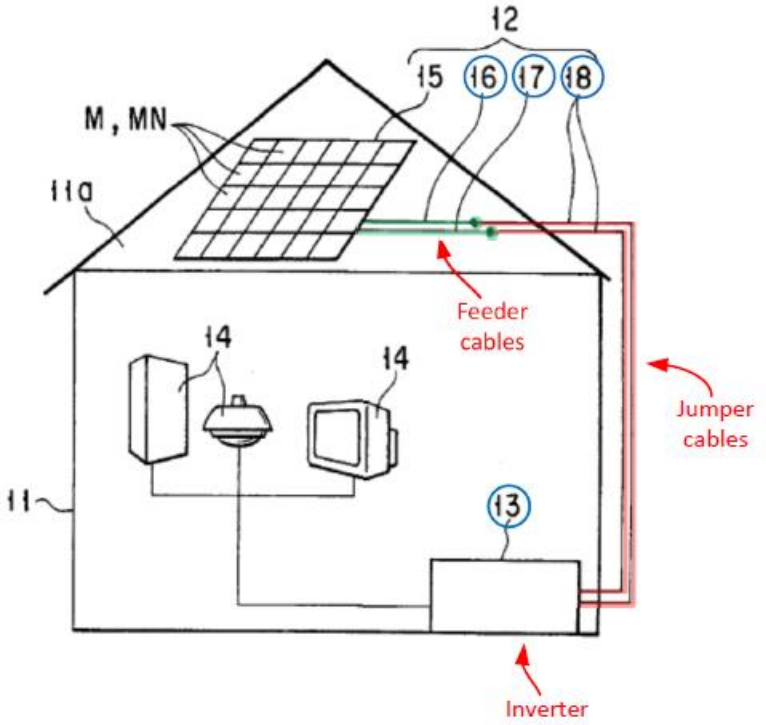
[94] Yamawaki is U.S. Patent No. 6,268,559, issued July 31, 2001, titled, "PHOTOVOLTAIC GENERATION SYSTEM, WIRING APPARATUS FOR PHOTOVOLTAC GENERATION SYSTEM, AND WIRING STRUCTURE THEREFOR." EX1006, cover page. Yamawaki addresses an existing challenge in solar installations, namely "fetching outputs conventionally requires use of many wiring apparatuses, so that the installation of the photovoltaic generation

system on a roof or the like costs much labor. Accordingly, there is a high possibility of misconnection. Since a large hole for a lot of wiring apparatuses must be bored through a wall of the building, so that sealing the building against rainwater and the like entails labor." *See id*., 2:5-11.

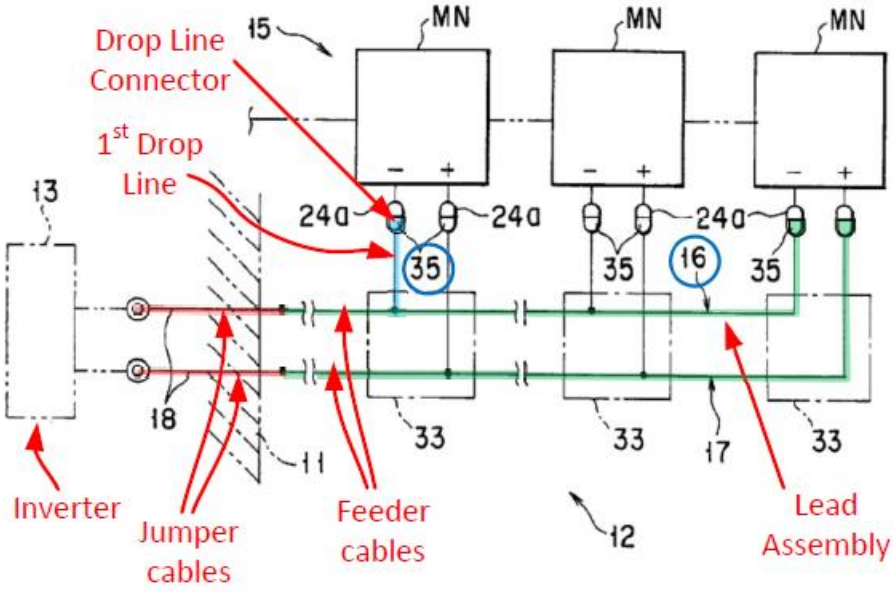
[95] Yamawaki describes an improved system to address this challenge:

> A plurality of photovoltaic modules, which are arranged side by side on a roof of a building or the like, or module units, composed of the modules, serve as generating sections. The respective outputs of the generating sections are lead into the building by means of a trunk conductor of the trunk cable. Each branch cable includes a branch conductor that is connected to the trunk conductor of the trunk cable. Each branch cable of the wiring apparatus is connected to a connector for use as an output terminal of the module units by means of a connector attached to the distal end portion thereof. The module units are connected in parallel with one another by means of the wiring apparatuses, and their respective outputs are supplied to loads in the building by means of a pair of lead-in wires.

EX1006, Abstract. As shown in Yamawaki, FIGS. 1 and 2, reproduced below with annotations, the feeder cables (i.e., wiring apparatus 16, 17) from the photovoltaic modules or module units (i.e., M, MN) connect the individual solar cells (i.e., photovoltaic panels 15) directly to an inverter unit 13 via jumper cables (i.e., lead-in wires 18).



EX1006, FIG. 1 (1st-annotation)



EX1006, FIG. 2 (1st-annotation)

[96] Similar to Solon741, Yamawaki discloses photovoltaic modules that may be arranged in various ways to overcome challenges and support the design of a

photovoltaic panel array, such as on a home solar energy installation. *See* EX1006, 7:54-8:11. Yamawaki demonstrates that various wiring assemblies, such as a wire harness directly connected to an array of solar panels and a lead assembly between that wire harness and an inverter and/or combiner box, may be connected at multiple different levels of a system hierarchy to aggregate power from the panels in steps. *See id*., FIGS. 3 and 5-7. A POSITA would have been motivated to combine the teachings of Yamawaki with those of Solon741 because Yamawaki discloses high-level and low-level details of various ways in which a POSITA would understand in order to connect and arrange wiring assemblies to form the structure of a photovoltaic generation system like that disclosed in Solon741. *See id*., 10:19-22 and 13:15-18.

[97] Yamawaki discloses details about branch connection joints of the wiring apparatus, including the application of an overmold over an undermold for providing added waterproofing protections for forming connection between a trunk cable and branch cable. *See id*., 6:1-65; FIG. 2-9B. Yamawaki describes the construction of the connection joint, which makes it clear that the trunk cable is a unitary cable that passes through the connection joint, and is electrically connected to the branch cable. *See id.,* 10:19-22 and 13:15-18. A POSITA would have been further motivated to augment the wiring assemblies disclosed by Solon741 by applying the teachings of Yamawaki for improved

resistance to humidity and environmental factors as well as increased installation efficiency. *See id*., 2:36-42.

[98] As the citations above show, Solon741 and Yamawaki discuss the design of cable junction elements that can be used to combine or distribute electrical power. The cable junction elements relate to the formation of a reliable electrical contact between different cables, protecting the connection from environmental factors and from handling, and providing the structures in a way that reduces cost and simplifies the assembly and maintenance of the power facilities. Both references focus on solar arrays and power distribution, plus the underlying mechanics, materials, assembly processes, molding processes, and other details are similar and worthy of considering in combination. Therefore, a POSITA would have been motivated to combine the teachings of Yamawaki with those of Solon741 and would understand how to apply the teaching of Yamawaki to the wiring assembly disclosed by Solon741 to produce systems with the benefits sought in both references.

[99] Likewise, the ’153 Patent claims relate not only to wiring assemblies in solar energy installations but also to in-line fuses for those assemblies. See EX1001, 4:51-55, and FIG. 5. Therefore, both Solon741 and Yamawaki are analogous prior-art to the ’153 Patent.

[100] During the prosecution of the patent application that resulted in the ’153

Patent, Applicant amended to overcomethe rejections in the Final Office Action based on Yamawaki as teaching the first drop line, feeder cable, and overmold/undermold. *See* EX1002, pp.70, 81. Applicant also did not rebut the Examiner's assertions that (1) the claim language of claim 1 did not require a central trunk or a wiring harness and only required a drop line connector configured to connect to a central trunk, or that (2) Yamawaki taught the limitation of a central trunk and wiring harness as required by claim 16. *Id*., pp.70, 82-84. Applicant also did not rebut Examiner's assertions that apertures are inherent in any rigid undermolded structure or that different diameters for connected cables would be obvious to try. *Id*., p.70, 81.

A POSITA would understand that the photovoltaic source circuit includes one or more sets of wiring assemblies that complete a circuit and provide the structure for making connections from the individual solar panels and/or array of solar panels. These wiring assemblies are typically joined together at a common connection point, such as an inverter. *See id*.

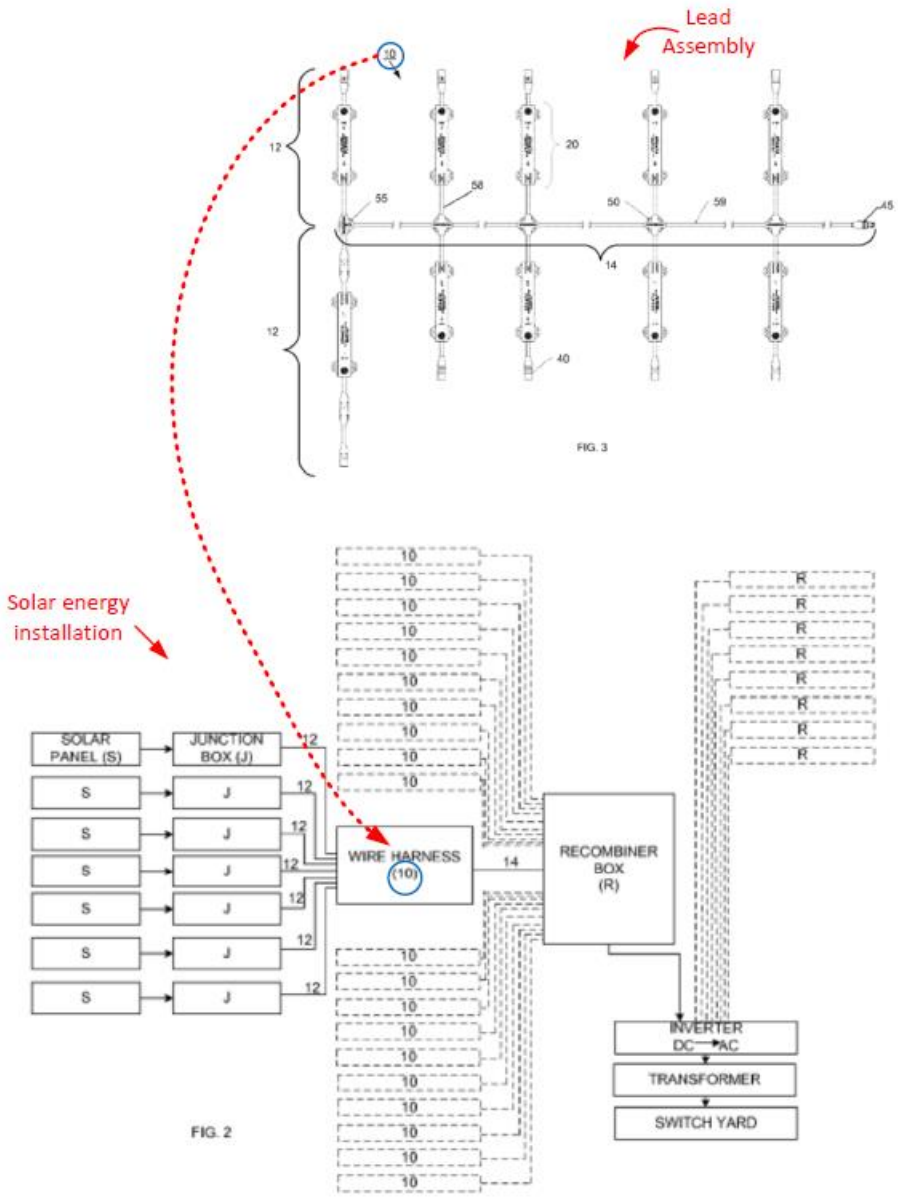
[101] A POSITA would have had an expectation of success in combining Solon741 with Yamawaki because a goal of Yamawaki is to "provide a wiring apparatus for a photovoltaic generation system, whereby the necessary number of electric wires for fetching outputs from generating sections, including a plurality of photovoltaic modules or module units, can be reduced, and which

can be easily laid with a lower possibility of wrong wiring." *Id.*, 2:45-51. Such teachings by Yamawaki are clearly applicable to the "components used in the solar energy industry and, more particularly, to wire harnesses with in-line fuses" disclosed in Solon741. *See* EX1005, ¶2. Therefore, a POSITA would expect the electrical and mechanical requirements of the wiring apparatus disclosed by Yamawaki to be similar to wire harnesses disclosed by Solon741.

1. Claim 1

Preamble. A lead assembly for use in a solar energy installation including:

[102] Solon741 discloses a lead assembly (FIG. 3) for use in a solar energy installation (FIG. 2). *See* EX1005, FIGS. 2 and 3 (combined with 1st-annotation), below.



EX1005, FIGS. 2 and 3 (combined with 1st-annotation)

[103] As shown above, Solon741 includes a number of individual solar panels (S) and numerous wiring assemblies, including wire harnesses 10, trunks 14, and branches 12 each feeding into a trunk 14. *See id.,* FIGS. 2 and 3 and ¶29. The wiring assemblies connect the solar panels to a common terminal of an inverter. The wiring assemblies provide a convenient structure for making connections to

and between the individual solar panels. In addition to the wire harness(es) connecting a series of solar panels, the set of cables would also include lead assemblies that are connected to the wire harnesses and come together at a single terminal of the inverter, a combiner box (e.g., "recombiner box R"), or another junction. An illustration from Solon741 of lead assemblies forming such a system is provided above, with annotations showing the arrangement of solar panels, wire harnesses, and lead assemblies that gather the electrical power from the solar panels and delivers the electrical power to a combiner box. *See* EX1007, p. 5, middle image (1st-annotation), above.

[104] Although the '153 Patent uses particular terminology for various elements of its wiring assemblies (e.g., "lead assembly," "feeder cable," drop line," and "wire harness"), a POSITA at the time the '153 Patent was filed would understand that such terminology is not universal within the industry. A POSITA familiar with the design and/or manufacture of electrical wiring and connectors, including photovoltaic wiring and connectors, would understand that the terms "wire harnesses" and "lead assemblies" both refer to wiring assemblies used for organizing and facilitating electrical connections within electrical power systems. While their roles differ between devices used for power combining or power distribution, the principles of their construction are the same and/or analogous. These distinctions do not change the fundamental

nature of both types of wiring assemblies, which are used in power gathering or power distribution systems. This conclusion is supported by the fact that the inventor of the '153 Patent (who was presumably a POSITA) used different terms for similar structures in the inventor's Solon741 patent which also relates to photovoltaic generation wiring and systems. In particular, the inventor's Solon741 patent uses the terms "wire harness," "branch wire." "trunk," "branch," and "cross joints" for the same types of structural elements that the '153 Patent calls the "lead assembly," "feeder cable," "drop," "drop line," and "joint," respectively. *See* EX1005, ¶29-30. Similarly, the Yamawaki reference, which like the '153 Patent relates to photovoltaic generation wiring and systems, uses the terms "wiring apparatus," "trunk cable," "branch cable," "branch," and "branch junctions," for structural elements the '153 Patent calls the "lead assembly," "feeder cable," "drop line," "drop," and "joint," respectively. *See* EX1006, 9:57-10:19.

[105] Despite the variations in terminology used in the field of photovoltaic electrical wiring and connectors, noted above, a POSITA would appreciate that the basic elements provide similar functions and have similar requirements. These assemblies all include junctions between cables, and the purpose is to merge or divide current from a power generation system or a power distribution system. For example, In Solon741 these junctions are called "cross joints 50"

or “tee joints 55,” while in Yamawaki these junctions are called “branch junctions 33.” *See* EX1005, ¶29 and EX1006, 10:17-19. These junctions allow multiple lower voltage wires to feed or drop into a feeder line configured to carry an accumulated higher voltage and the sizing of such lines must meet the requirements of local electrical codes. *See e.g.,* EX1010, 690.8(A)(1) through (A)(4), p. 546. Accordingly, a POSITA would have understood that any solar array installation will include a hierarchy of branches even though the wires and connections may be given different names despite operating in the same manner in the same hierarchy.

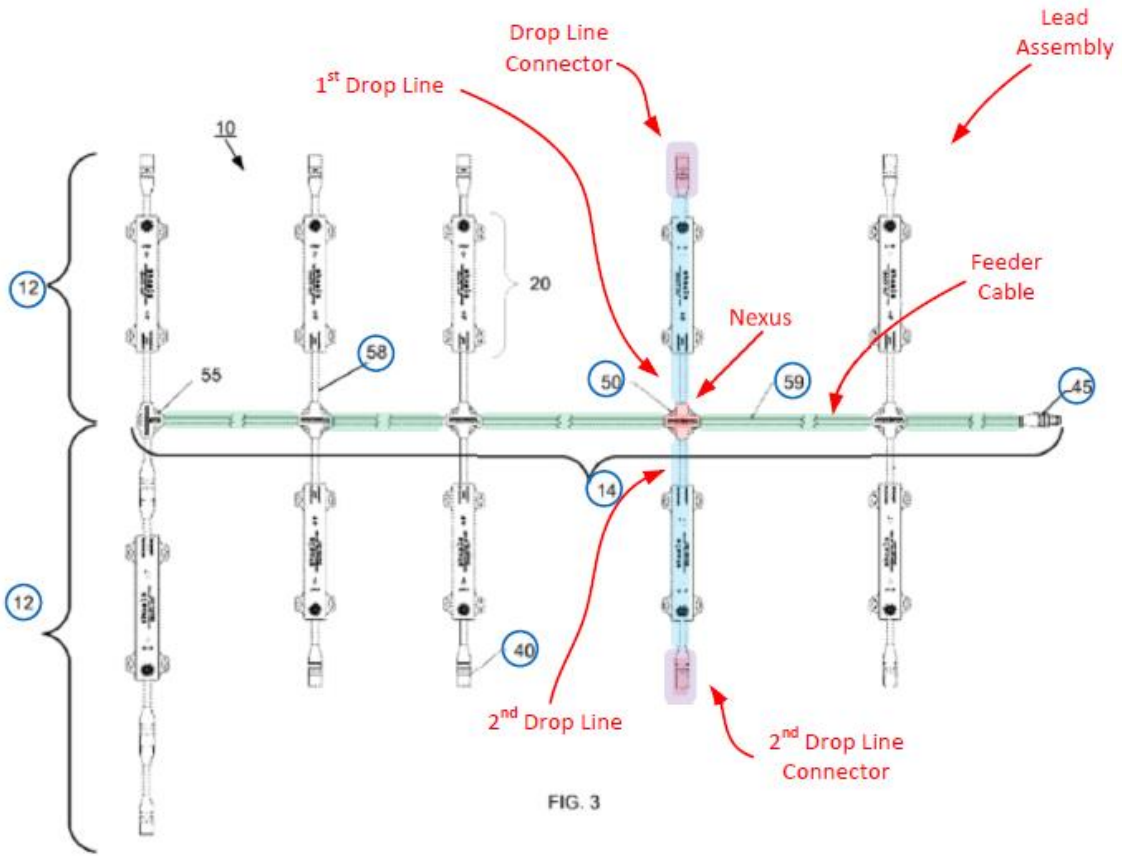
[106] Main cables supplying power and carrying higher currents may be referred to with such terms as “trunks,” “trunk cables,” “trunk conductors,” “main cables,” “feeder cables,” or the like. Similarly, the smaller diameter cables branching off a main cable and carrying lower currents may be referred to with terms such as “branches,” “branch cables,” “branch conductors,” “branch lines,” “drops,” “drop lines,” or the like (and even amongst these terms, there may be nuanced understandings, such as a “drop line” potentially referring to a unitary physical wire, while “drops” may refer to wire ends that are electrically connected to a feeder cable, regardless of whether, for example, one drop line is used to form two drops). Also, wiring assemblies that join electrical components and/or wires may be referred to with terms such as “wire

harnesses," "lead assemblies," "wiring apparatus," or the like depending upon local and/or regional parlance. As demonstrated by the PSE textbook, a POSITA would have understood that it is important to use appropriately sized cables for the intended application, have very good electrical connections within these junctions to prevent resistance drops and overheating, and provide protective insulation to prevent the effects of external environments from causing corrosion or failure of the cables and junctions. See, EX1011, p. 127.

[107] For these reasons, a POSITA would have found the limitations in claim 1(Preamble) to be obvious in view of Solon741.

a. a drop line terminating at a drop line connector, the drop line connector configured to connect with a central trunk of a wire harness, the central trunk of the wire harness having a plurality of branches that each are configured to electrically connect to a separate solar panel contained in an array of a plurality solar panels;

[108] Solon741 discloses multiple drop lines (i.e., branches 12) branching off a feeder cable (i.e., trunk 14). *See* EX1005, FIG. 3 (1st-annotation), below. Solon741 FIG. 3 is annotated below to highlight how sets of two drop lines (one set of two drop lines annotated in blue, below) branch in opposite directions from the feeder cable (annotated in green, below). *See id*. Each of the drop lines (i.e., branches 12) include a branch wire (58) extending from a cross joint (50) and terminating in a drop line connector (i.e., connector 40). *See id*.



EX1005, FIG. 3 (1st-annotation)

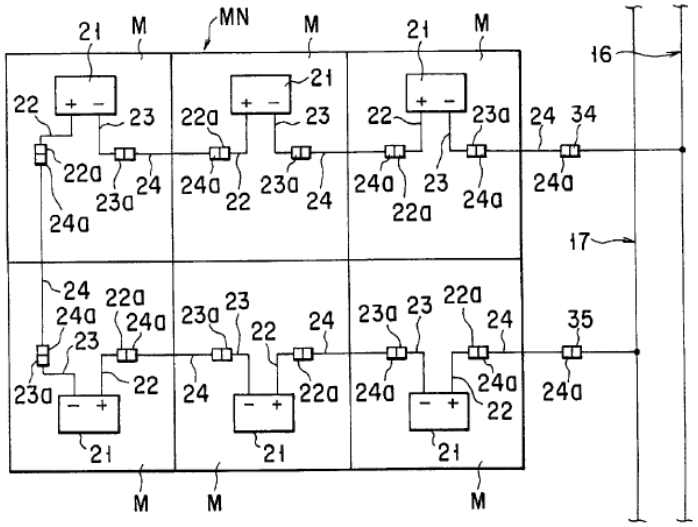
[109] Solon741 also discloses that the drop lines (i.e., branches 12) from the lead assembly (i.e., wire harness 10) are connected to a plurality of solar panels (S). *See id.*, FIG. 2 and ¶26. Although Solon741 does not explicitly disclose that the drop line connectors from each drop line are connected to a central trunk of another wiring assembly (i.e., a wire harness), a POSITA would appreciate that it would be expensive and complicated to route individual wires from each solar panel all the way to the final terminal of the inverter.

[110] For example, the disclosure of Yamawaki demonstrates that it was known to

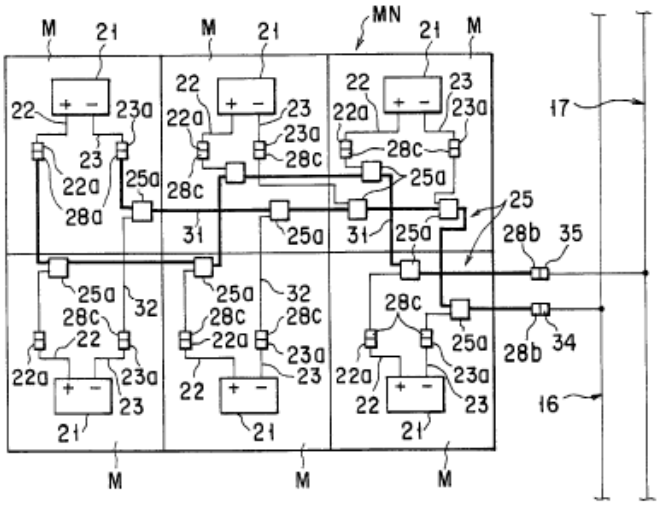
include wire harnesses coupled to other wire harnesses and cable assemblies for combining the current from solar panels to deliver to a common connection point, such as the inverter or junction box. In particular, Yamawaki shows a wire harness associated with six modules M:

> The six modules M that constitute each module unit MN are connected in series and/or parallel with one another, depending on the required output. Six modules M shown in FIG. 4 are connected in series with one another by means of connecting wires 24. Six modules M shown in FIG. 5 or 6 are connected in parallel with one another by means of wiring apparatuses 25 or 26. Six modules M shown in FIG. 7 are connected in Series and parallel with one another by means of wiring apparatuses 27.

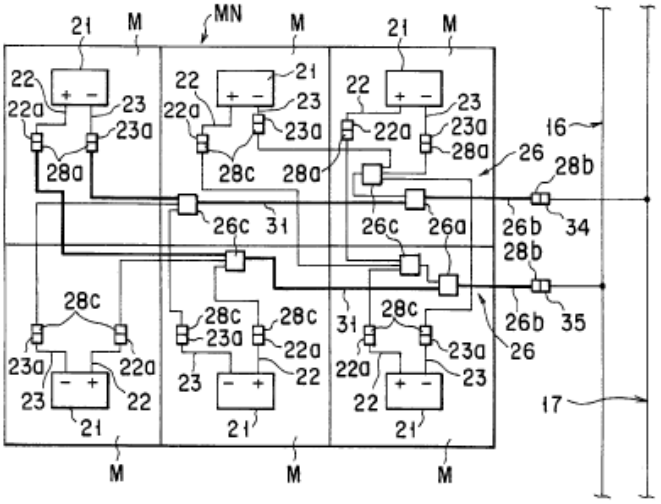
EX1006. Col. 8, lines 17-26 and *see* FIG. 4-6, below.



EX1007, FIG. 4



EX1007, FIG. 5



EX1007, FIG. 6

[111] Yamawaki describes an example of the use of a wiring apparatus (i.e., harnesses) and junctions for a building. *See id*., generally. A POSITA would understand that the various different arrangements for solar installations disclosed by Yamawaki could be applied as needed. *See* EX1006, 8:15-20 and FIG. 3. Also, a POSITA would understand that the arrangement of wiring

assemblies disclosed by the first embodiment of Yamawaki can be extended and combined with Solon741 to more efficiently connect the solar installation disclosed by Solon741. (*see* 'B(i) Motivation to Combine Solon741 and Yamawaki further discussed above). Therefore, as demonstrated by Yamawaki, a POSITA would recognize that including intermediate wire harnesses can provide a practical and obvious way to combine the current from a collection of panels, and that such intermediate cable assemblies provide a practical and obvious way to combine the current from a collection of wire harnesses for delivery to a final terminal of the inverter or combiner box. *See id*.

[112] As illustrated in the annotated drawings from Solon741, above (e.g., EX1005, FIGS. 2 and 3 (combined with 1st-annotation)), the products described in Solon741 include a number of lead assemblies (i.e., wire harnesses 10) with feeder cables and drop lines that connect to solar panel arrays. The illustrations and other information reproduced above describe junctions that provide an electrical connection between each drop line and feeder cable, along with encapsulation needed to protect the metal wires at the junction from the external environment. The illustration from Solon741 reproduced above shows one example of a combination of components (i.e., a use case for different components). A POSITA would understand that there are many, many other ways to combine the individual Solon741 lead assemblies (i.e., wire harnesses

10) with feeder cables and drop lines to construct a solar energy installation to match the geometry and design of any particular application. Further, a POSITA, being knowledgeable about the basics of electrical wiring, and guided by the NEC 2002 and/or the PSE textbook would be able to interpret the individual technical information of each element in such lead assemblies (e.g., wire harnesses, feeder cables and drop lines) to select the proper gauges of wires and specify a lead assembly design that would be needed to accommodate the current and voltage characteristics of a given solar array installation. *See* EX1010, p. 546 (690.8 Circuit Sizing and Current) and EX1011, p. 125-127 (4.4.4 Balance of System).

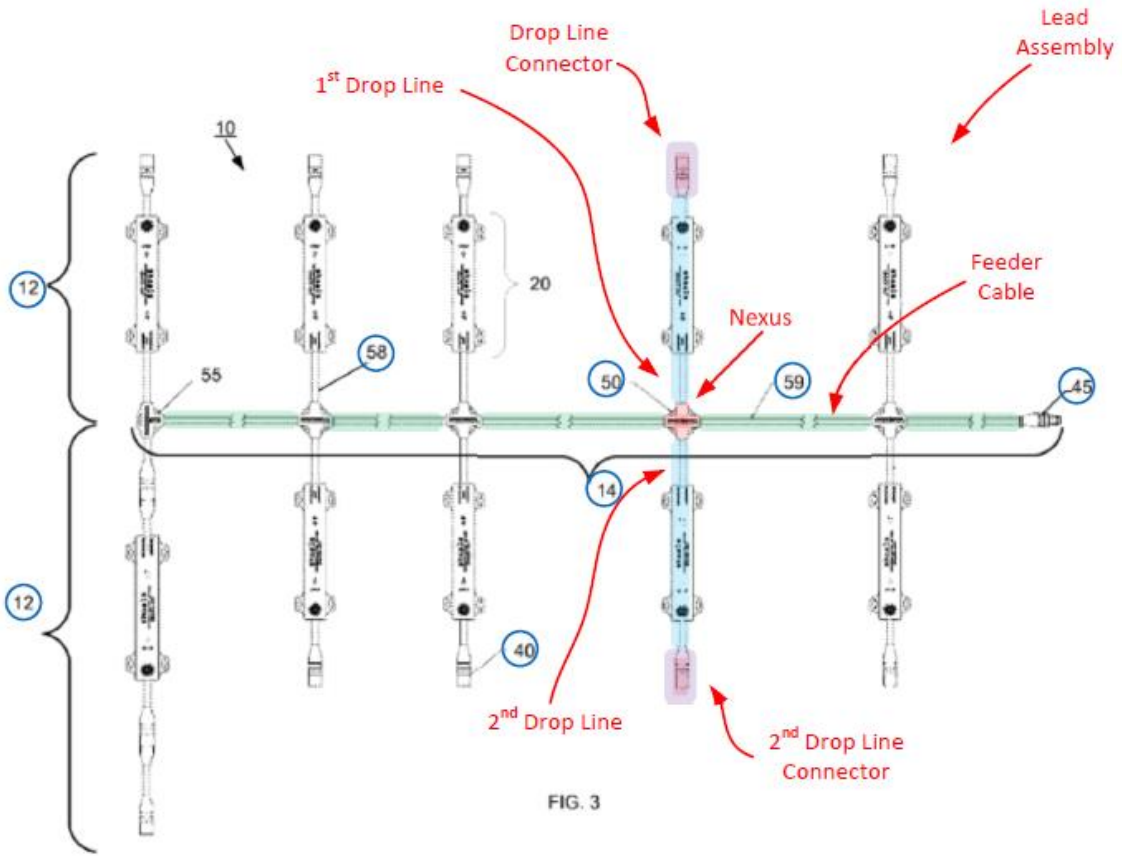
[113] A POSITA would know how to combine the wiring elements from Solon741 to connect a plurality of solar panels to a wire harness, including using a drop line, via a drop line connector, to a lead assembly. The drop line connectors of Solon741 are configured to make electrical and physical connections with a central trunk of another wire harness. In order to meet the electrical requirements of any particular installation, a POSITA would understand that the feeder and branch portions of the circuit must comply with electrical engineering standards and codes. *See*, EX1010, p. 546 (690.8(B)(1) and EX1011, pp. 106-108.

[114] For these reasons, a POSITA would have found the limitations in claim 1(a)

to be obvious based on Solon741 in view of Yamawaki.

b. a feeder cable electrically coupled to the drop line at a nexus;

[115] Solon741 discloses a feeder cable (i.e., trunk 14) electrically coupled to drop lines (i.e., branches 12) at a nexus (i.e., cross joints 50). *See* EX1005, ¶29 and FIG. 3 (1st-annotation), below.



EX1005, FIG. 3 (1st-annotation)

[116] Although Solon741 does not directly disclose many details regarding electrical coupling inside the cross joints (50), the specification of Solon741 indirectly discloses aspects of the construction of the electrical coupling inside the cross joints (50) by incorporating by reference "U.S. patent application Ser.

No. 12/502,395, which was filed Jul. 14, 2009," which patent application published as US2011/0011642A1 to Solon (i.e., "Solon642"). *See* EX1005, ¶29. In this regard, Solon642 discloses details that a POSITA would have known regarding how the wires are stripped and coupled before being molded inside the cross joints (50). *See* EX1016, ¶¶27-30 and FIGS. 9A-9E. Moreover, a POSITA considering Solon741 would be informed to refer to Solon642 for such details of the construction of the electrical coupling inside the cross joints.

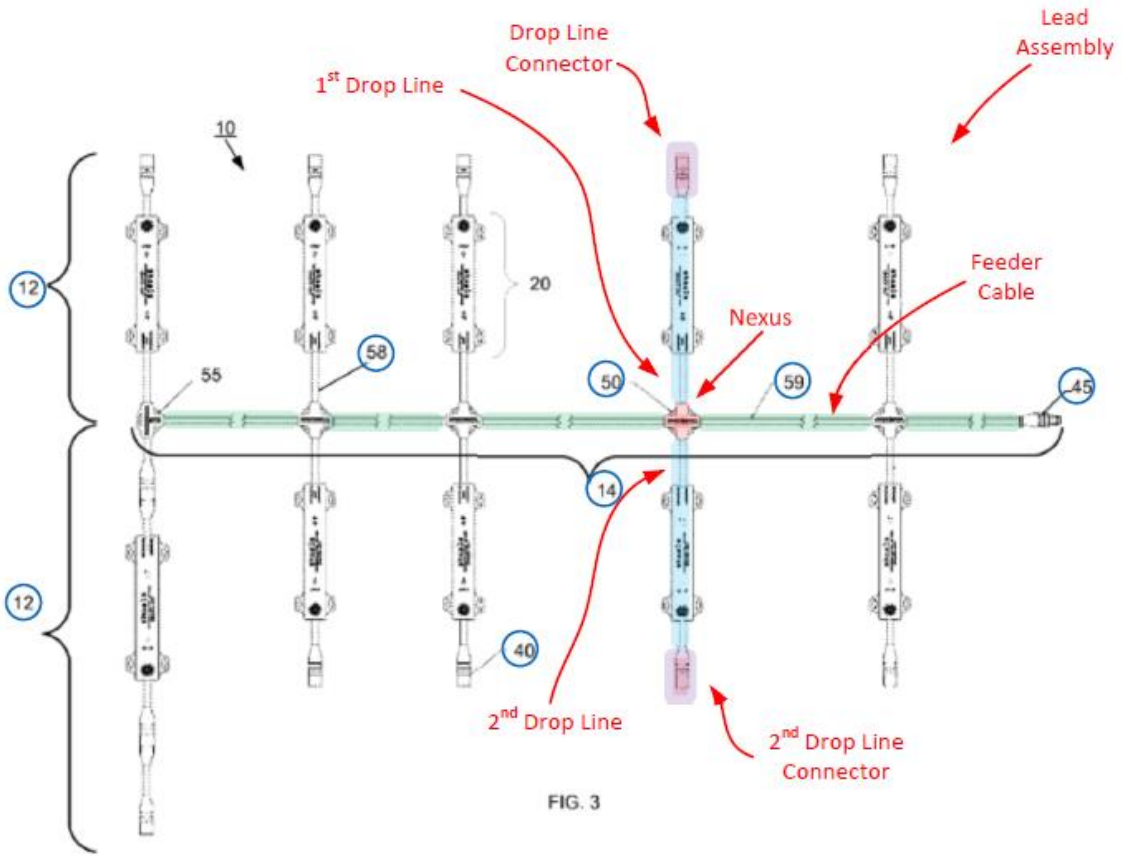
[117] For these reasons, a POSITA would have found the limitations in claim 1(b) to be obvious in view of Solon741.

c. an undermold that fully encases the nexus, the undermold further comprising:

[118] The specification of the '153 Patent does not define the term "undermold." Based on illustrations in the '153 Patent and the plain and ordinary meaning of the term "undermold" in the context of the claim, it is my opinion that a POSITA would have understood that the use of the word "undermold" in the '153 Patent claims meant a "material molded over a piece or part that seals against environmental factors and is surrounded by an 'overmold'." *See* EX1001, FIGS. 48, 54, 55, 60 and generally. I note that this understanding is similar to the definition of "undermold" as any "material molded over a piece or part that seals against environmental factors and is surrounded by an

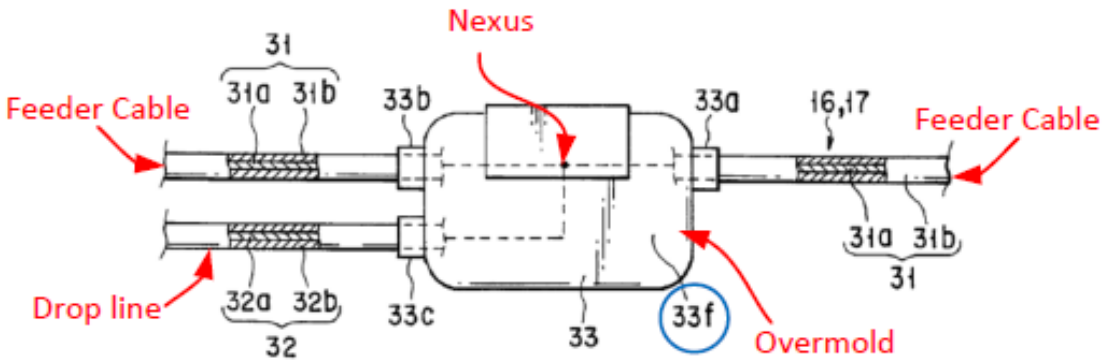
overmold," which was adopted by an Order in parallel proceedings before the International Trade Commission involving the '153 Patent, for construing claims in U.S. Patent No. 10,553,739 (the "'739 patent"), which shares the same inventor. *See* EX1017, 17:8-1 and 20:14-15. While that construction of "undermold" was specifically for the claims of the '739 patent, that construction is informative for establishing how a POSITA would understand the term in the context of the '153 Patent claims since the technology and application is similar.

[119] As shown in the illustration reproduced below, the molded junction covering the union of the various wires at the nexus in Solon741 is an undermold that fully encases the conductive coupling of wires because the molded junction covering the nexus serves as a substrate for an overmold. *See* EX1005, FIG. 3, (1st-annotation), below.

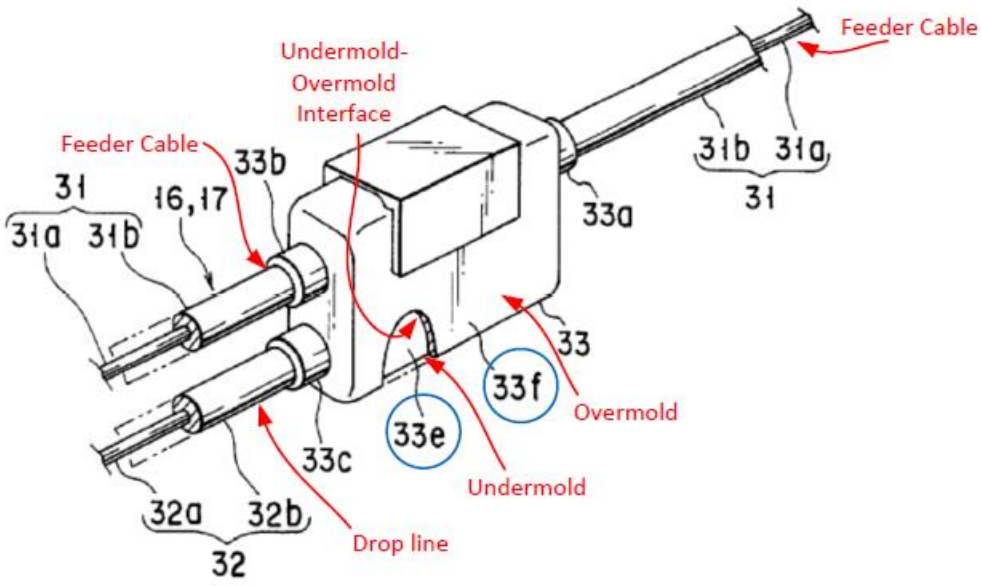


EX1005, FIG. 3 (1st-annotation)

[120] Yamawaki also teaches this limitation. Yamawaki teaches applying an overmold over an undermold of a branch cable connection to provide an added layer of waterproofing. *See* EX1006, 10:19-22; 13:15-18. In particular, Yamawaki discloses, and shows in illustrations reproduced below, applying an overmold (i.e., covering member 33f) over the undermold (i.e., molded underbody 33e) covering a nexus (i.e., a branch junction) of cables (i.e., a feeder cable and a branch cable). *See id.*, FIGS. 9A (1st-annotation) and 9B (1st-annotation), below.



EX1007, FIG. 9A (1st-annotation)



EX1007, FIG. 9B (1st-annotation)

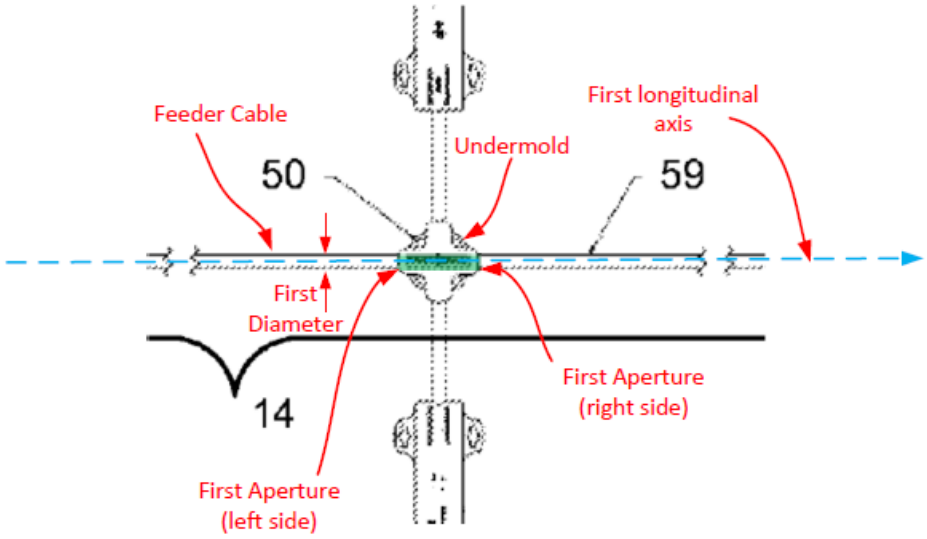
[121] A POSITA considering Solon741 and Yamawaki would appreciate that these two disclosures describe methods for encasing cable junctions with insulating layers that can provide protection from the environment and other benefits discussed earlier with respect to Yamawaki (*see* 'B(i) Motivation to Combine Solon741 and Yamawaki' further discussed above). A POSITA

considering Solon741 and Yamawaki would have found it obvious to include an undermold in the Solon741-Yamawaki combination in order to provide protection against environmental elements (e.g., waterproofing), as taught by Yamawaki (*see* 'B(ii) Motivation to Combine Solon741 and Yamawaki" further discussed above).

[122] For these reasons, a POSITA would have found the limitations in claim 1(c) to be obvious in view of the Solon741-Yamawaki combination.

i. a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis; and

[123] Solon741 discloses, and shows in an illustration reproduced below, a first aperture (e.g., annotated in green highlighting, below) extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis. *See* EX1005, FIG. 3 (Relief and 2nd-annotation), reproduced below.



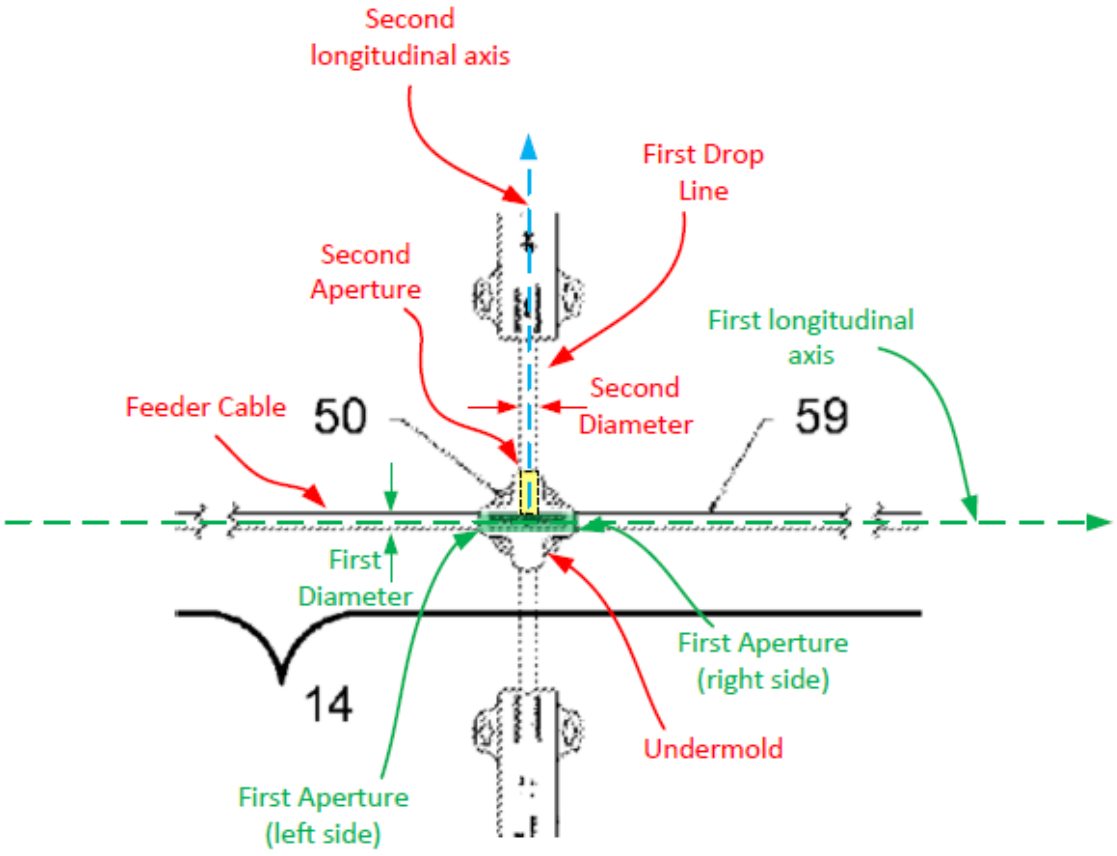
EX1005, FIG. 3 (Relief and 2nd-annotation)

[124] Although Solon741 does not specifically mention many details regarding the cross joints (50), the specification of Solon741 indirectly informed POSITAs about the construction of the cross joints (50) by incorporating by reference "U.S. patent application Ser. No. 12/502,395, which was filed Jul. 14, 2009," which patent application published as Solon642. *See* EX1005, ¶29. In this regard, Solon642 discloses details a POSITA would have known regarding the exterior attachment apertures in the cross joints (50), which are a different kind of aperture from the passages that extend through the cross joints (50). *See* EX1016, ¶¶27-30 and FIGS. 9A-9E. Thus, a POSITA considering Solon741 would be informed of the construction of the cross joints as in Solon642.

[125] For these reasons, a POSITA would have found the limitations in claim 1(c)(i) to be obvious in view of the Solon741-Yamawaki combination.

ii. a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis;

[126] Solon741 discloses, and shows in an illustration reproduced below, a second aperture (e.g., annotated in yellow highlighting, below) extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis. *See* EX1005, (Relief and 3rd-annotation), reproduced below.



EX1005, FIG. 3 (Relief and 3rd-annotation)

[127] I note that although Solon741 does not explicitly illustrate that the first diameter of the first aperture is larger than the second diameter of the second aperture, the Specification of Solon741 does disclose that the feeder cable (i.e., the trunk 14) is constructed of "10 or 8 gauge photovoltaic wire," while the drop line (i.e., the branch 12) is constructed of "10 or 12 gauge photovoltaic wire." *See id.*, ¶29. A POSITA would understand that this means that Solon741 discloses variations in the wire sizes that can be used, including configurations using a larger feeder cable (e.g., 8 gauge) in combination with a

smaller drop line (e.g., 12 gauge). Also, since the undermold (i.e., cross joint 50) must cover, seal, and protect the junction of wires (i.e., the feeder cable and the drop line(s)), it naturally follows that the first diameter of the first aperture, with its larger feeder cable, must be larger than the second diameter of the second aperture with its smaller drop line. Thus, a POSITA would understand from the disclosure in Solon741 that a second diameter of the second aperture may be smaller (i.e., different) than the first diameter of the first aperture.

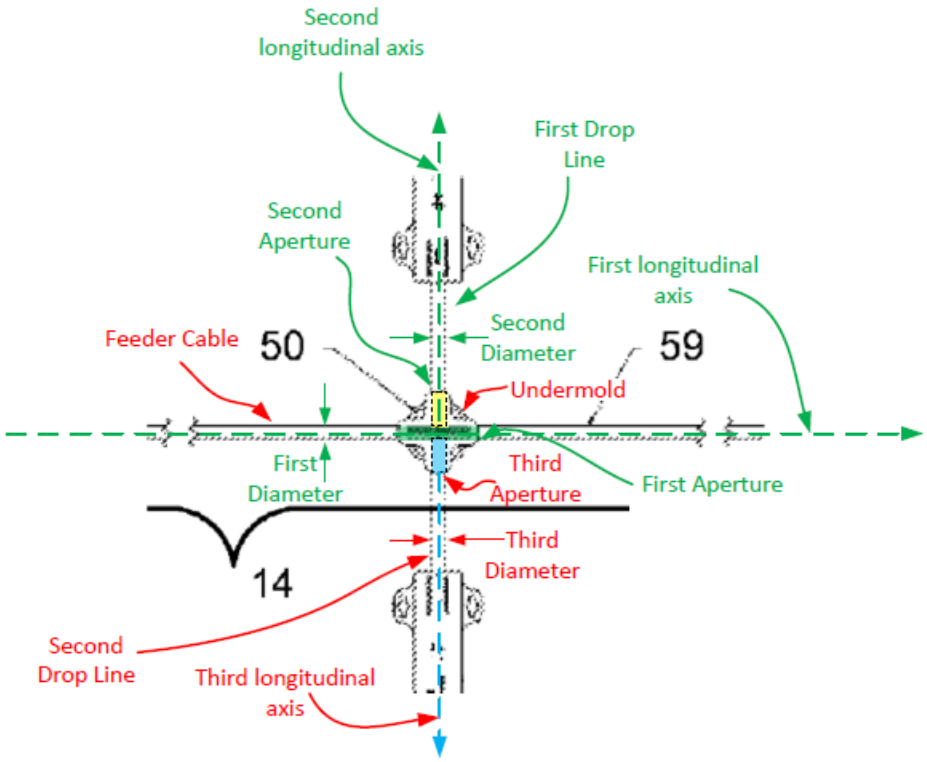
[128] Further, the disclosure of Solon741 does not include a detailed discussion of the assembly process of the harness shown in FIG. 3. A POSITA would understand and find obvious that this process discusses connection of cables (which become the first and second drop lines shown in the figure above) to the trunk, forming a pair of apertures that extend part way through the mold.

[129] For these reasons, a POSITA would have found the limitations in claim 1(c)(ii) to be obvious in view of the Solon741-Yamawaki combination.

iii. a third aperture extending partially through the undermold and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis; and

[130] Solon741 discloses, and shows in an illustration reproduced below, a third aperture (e.g., annotated in blue highlighting, below) extending partially through the undermold and having a third diameter different than the first diameter, wherein the drop line extends from the third aperture along a third

longitudinal axis. *See* EX1005, (Relief and 4th-annotation), below.



EX1005, FIG. 3 (Relief and 4th-annotation)

[131] As noted above, Solon741 discloses that the feeder cable (i.e., trunk 14) may be a lower gauge (i.e., a thicker wire) than the drop lines (i.e., branches 12), which may have a higher gauge (i.e., a thinner wire). *See id.*, ¶29. Also, since the undermold (i.e., cross joint 50) must cover, seal, and protect the junction of wires (i.e., the feeder cable and the drop line(s)), it naturally follows that the first diameter of the first aperture, with its larger feeder cable, must be larger than the third diameter of the third aperture with its smaller drop line. Thus, a POSITA would understand from the disclosure in Solon741 that a third

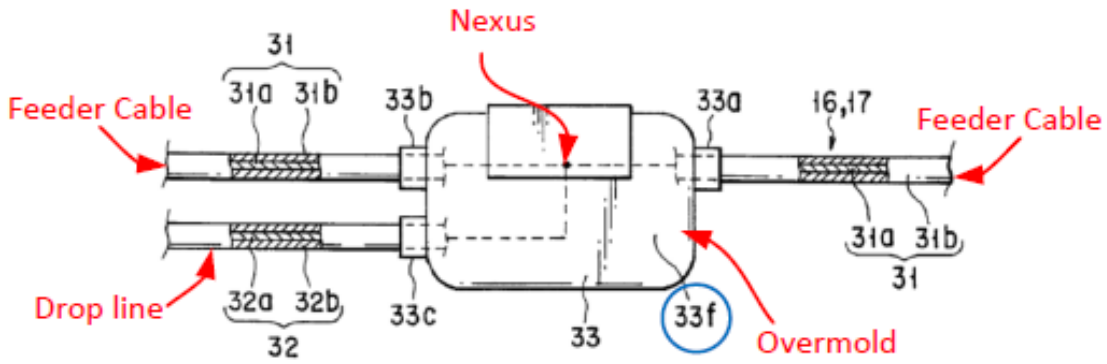
diameter of the third aperture may be smaller (i.e., different) than the first diameter of the first aperture.

[132] Further, the disclosure of Solon741 does not include a detailed discussion of the assembly process of the harness shown in FIG. 3. A POSITA would understand and find obvious that this process discusses connection of cables (which become the first and second drop lines shown in the figure above) to the trunk, forming a pair of apertures that extend part way through the mold.

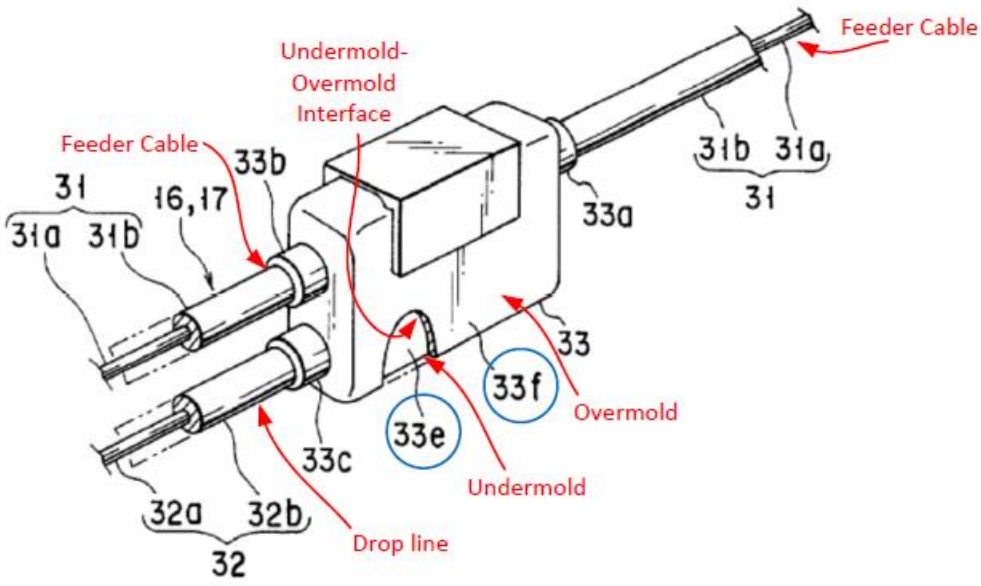
[133] For these reasons, a POSITA would have found the limitations in claim 1(c)(iii) to be obvious in view of the Solon741-Yamawaki combination.

d. an overmold surrounding the undermold and forming an undermold-overmold interface at an outer surface of the undermold.

[134] Yamawaki teaches applying an overmold over an undermold of a branch cable connection to provide an added layer of waterproofing. *See* EX1006, 10:19-22; 13:15-18. In particular, Yamawaki discloses applying a covering member (i.e., an overmold) over the molded underbody (i.e., an undermold) covering a branch junction (i.e., a nexus) of cables (i.e., a feeder cable and a branch cable). *See id*. As shown in FIGS. 9A (1st-annotation) and 9B (1st-annotation) reproduced below. *See* FIGS. 9A (1st-annotation) and 9B (1st-annotation), below.



EX1007, FIG. 9A (1st-annotation)



EX1007, FIG. 9B (1st-annotation)

[135] A POSITA considering Yamawaki would appreciate that Yamawaki describes methods for encasing cable junctions with insulating layers that can provide protection from the environment and other benefits discussed earlier with respect to Yamawaki (*see* 'B(ii) Motivation to Combine Solon741 and Yamawaki' further discussed above). A POSITA considering Yamawaki

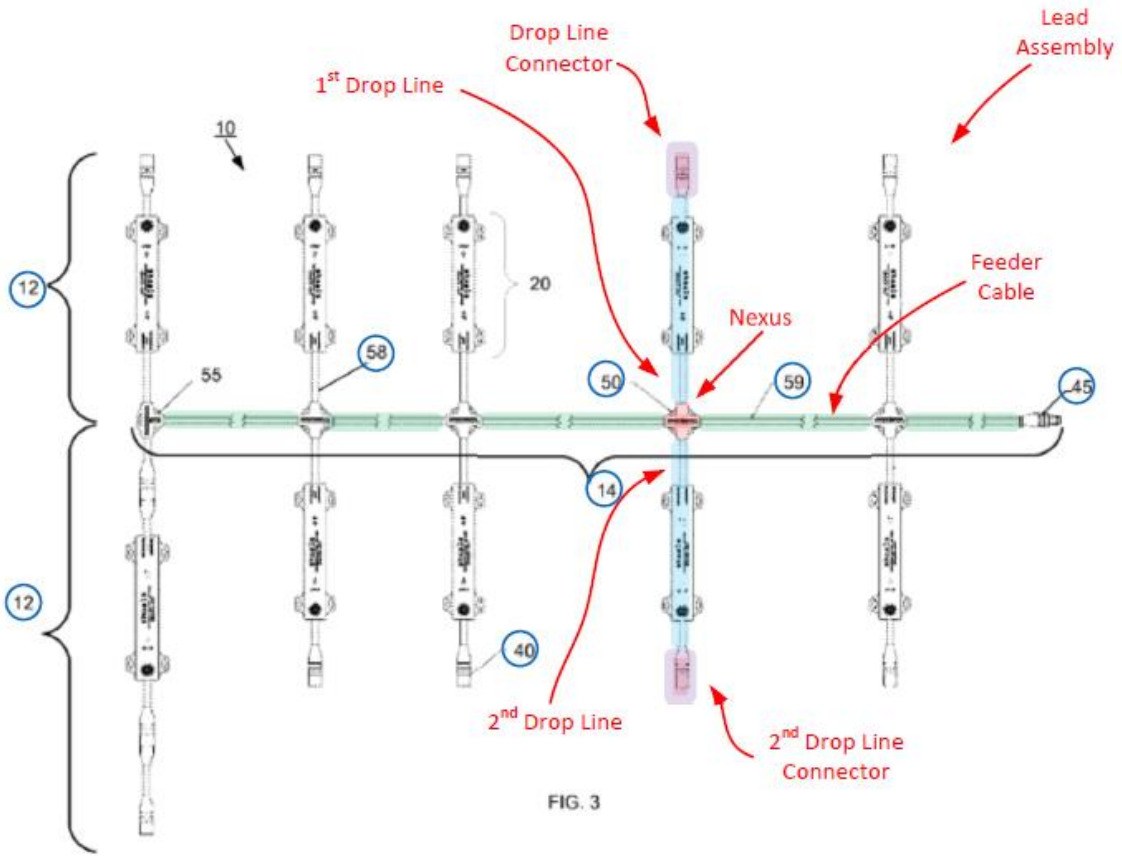
would have found it obvious to add an overmold to Solon741 in order to provide the added protection against environmental elements (e.g., waterproofing), as taught by Yamawaki (*see* 'B(ii) Motivation to Combine Solon741 and Yamawaki' further discussed above). For these reasons, a POSITA would have found the claim 1(d) limitations to be obvious in view of the Solon741-Yamawaki combination.

[136] For all these reasons, a POSITA would have found claim 1 to be obvious based on the Solon741-Yamawaki combination. Accordingly, claim 1 should be found invalid under 35 U.S.C. § 103 based on Solon741 and Yamawaki.

2. Claim 5

The lead assembly of claim 1, wherein the feeder cable terminates at a feeder cable connector.

[137] Solon741 discloses, and shows in an illustration reproduced below, that the feeder cable (i.e., trunk 14) terminates at a feeder cable connector (i.e., connector 45), which is shown below at the right end of the feeder cable. *See* EX1005, ¶29 and FIG. 3 (1st-annotation), reproduced below.



EX1005, FIG. 3 (1st-annotation)

[138] For these reasons, a POSITA would have found the limitations in claim 5 to be obvious in view of the Solon741-Yamawaki combination.

3. Claim 6

The lead assembly of claim 5, wherein the feeder cable connector is configured to attach directly to an inverter.

[139] I am informed by Counsel that the recitation of "the feeder cable connector is configured to attach directly to an inverter," is an intended use limitation since it recites a feature (i.e., the feeder cable connector) by what it does (i.e.,

attach directly to an inverter) rather than by what it is. Although Solon741 does not disclose the feeder cable connector being attached directly to an inverter, this alternative configuration was well known to POSITAs. For example, Figure 690.1(B), top diagram of the NEC 2002 illustrates the main feeder cable of a branching "photovoltaic source circuit" connected directly to an inverter. *See* EX1010, Fig. 690.1(B), p.544.

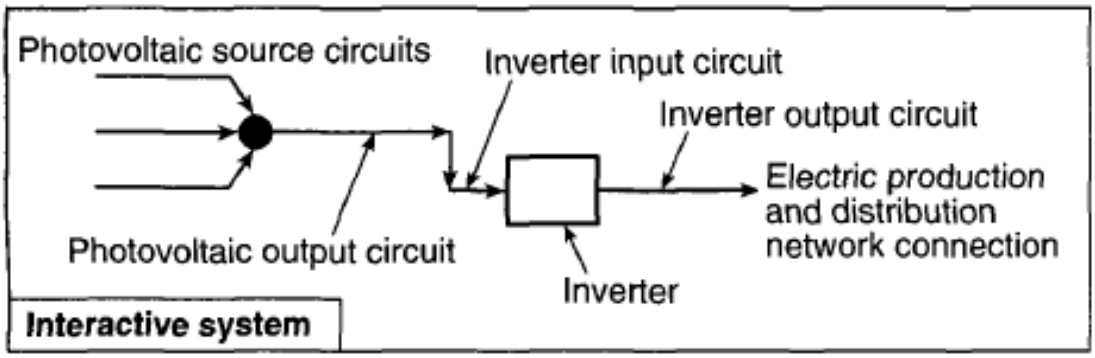


Figure 690.1(B) (top diagram)

[140] Further, a POSITA would have been motivated to attach a feeder cable directly to an inverter, particularly for installations in which the inverter is in close proximity and can extend to be connected directly to feeder cable without the need for a jumper cable. *See id*.

[141] A POSITA would further understand that the combiner box is one example of a convenient means for merging current from several lead assemblies to a single cable that is applied to the terminal of the inverter. Alternately, a POSITA would understand that the cable assemblies may be arranged so that all of the current from the solar panels in the installation are brought together

through a series of junctions and or branch structures through a series of wire harnesses, as taught by Yamawaki, to a single cable that can be applied to the terminal of the inverter without need for a combiner box. *See* EX1006, FIGS. 3 and 5-7. Additionally, for installations in which the feeder cable from the lead assembly is very close to the inverter, there is no need to use the jumper cable, which only serves as an extension conductor attaching to the inverter.

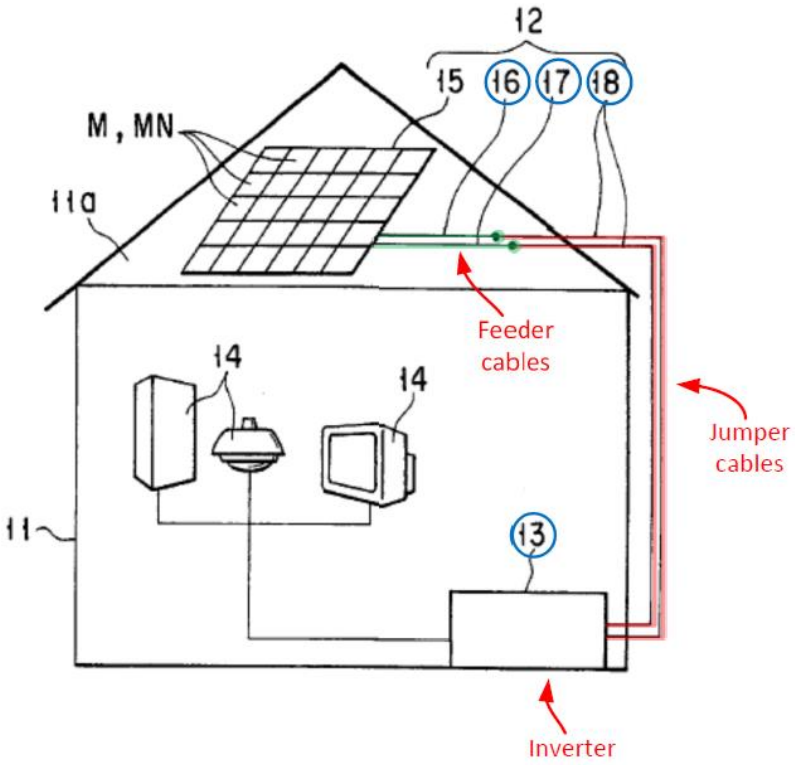
[142] Therefore, it would have been obvious to a POSITA to attach the feeder cable connector directly to an inverter based on the disclosure of Solon741 and well known design choice. For these reasons, a POSITA would have found the claim 6 limitations to be obvious in view of the Solon741-Yamawaki combination.

4. Claim 7

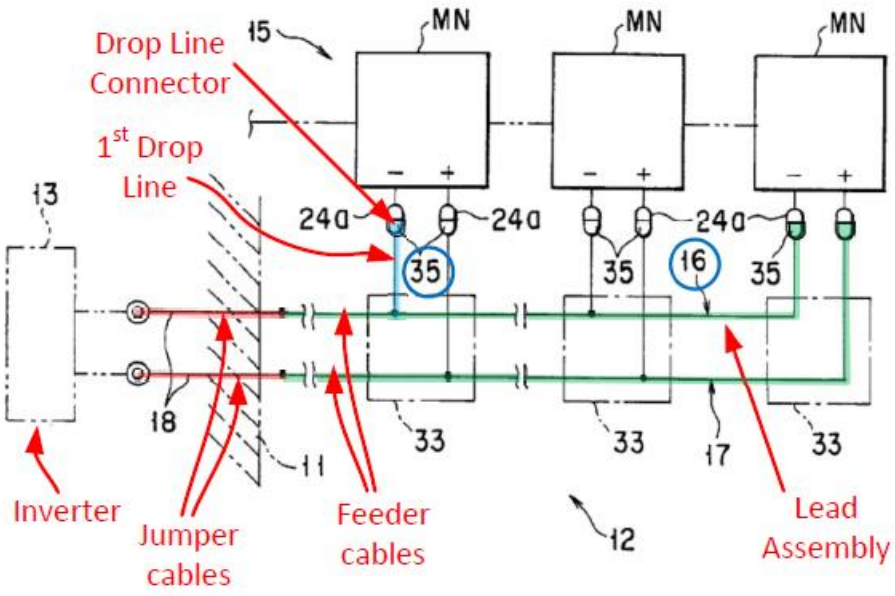
The lead assembly of claim 5, wherein the feeder cable connector is configured to attach directly to a jumper cable, which in turn connects directly to an inverter.

[143] I am informed by Counsel that the recitation of "the feeder cable connector is configured to attach directly to a jumper cable, which in turn connects directly to an inverter," is an intended use limitation since it recites a feature of a feeder cable connector by what it does (e.g., attach directly to a jumper cable) rather than by what it is. Regardless, as discussed above with regard to the limitations of claim 6, the Solon741-Yamawaki combination teaches attaching a

feeder cable directly to a jumper cable, which in turn connects directly to an inverter, as shown in the illustrations reproduced below. *See* EX1006, 7:45-8:11, FIG. 1 (1st-annotation), and FIG. 2 (1st-annotation).



EX1006, FIG. 1 (1st-annotation)



EX1006, FIG. 2 (1st-annotation)

[144] A POSITA would further understand that the disclosure of Yamawaki could be applied to large-scale solar installations as discussed in the figures and descriptions of FIG. 3, which disclose example arrangements for 8 sets of solar modules. From these descriptions in Yamawaki, a POSITA would understand that the cabling arrangements disclosed in the Solon741-Yamawaki combination could be extended to larger scale installations using the teachings of Yamawaki. To meet the specific current and voltage requirements associated with larger-scale installations, a POSITA would make straightforward design decisions using well-known standards and references, such as the NEC 2002, using Table 310.16, to select cables, connectors and associated components that are individually rated for the higher current and higher voltage of the particular installation. *See* EX1010, p. 149. The design and manufacture of such

components could rely on the teachings of Yamawaki and achieve operation at higher voltage and current simply by selecting materials and dimensions of the cables and cable junctions according to standard industry practice, again relying on standards such as the NEC 2002 (e.g., using Table 310.16) as referenced above. *See id.*

[145] A POSITA considering Yamawaki would have found it obvious to attach a feeder cable in Solon741 directly to a jumper cable, which in turn connects directly to an inverter in order to simplify and customize the installation, as taught by Yamawaki in order to simplify the wiring installation. *See* 'B(ii) Motivation to Combine Solon741 and Yamawaki' further discussed above. For the foregoing reasons, a POSITA would have found the claim 7 limitations to be obvious in view of the Solon741-Yamawaki combination.

[146] For all of the foregoing reasons, a POSITA would have found the limitations in claim 7 to be obvious in view of Solon741 and Yamawaki.

5. Claim 11

The lead assembly of claim 1, wherein the drop line includes a fuse.

[147] Solon741 discloses, and shows in an illustration reproduced below, that the drop lines (i.e., branches 12) include a fuse (20). *See* EX1005, ¶29 and FIG. 3 (2nd-annotation), reproduced below.

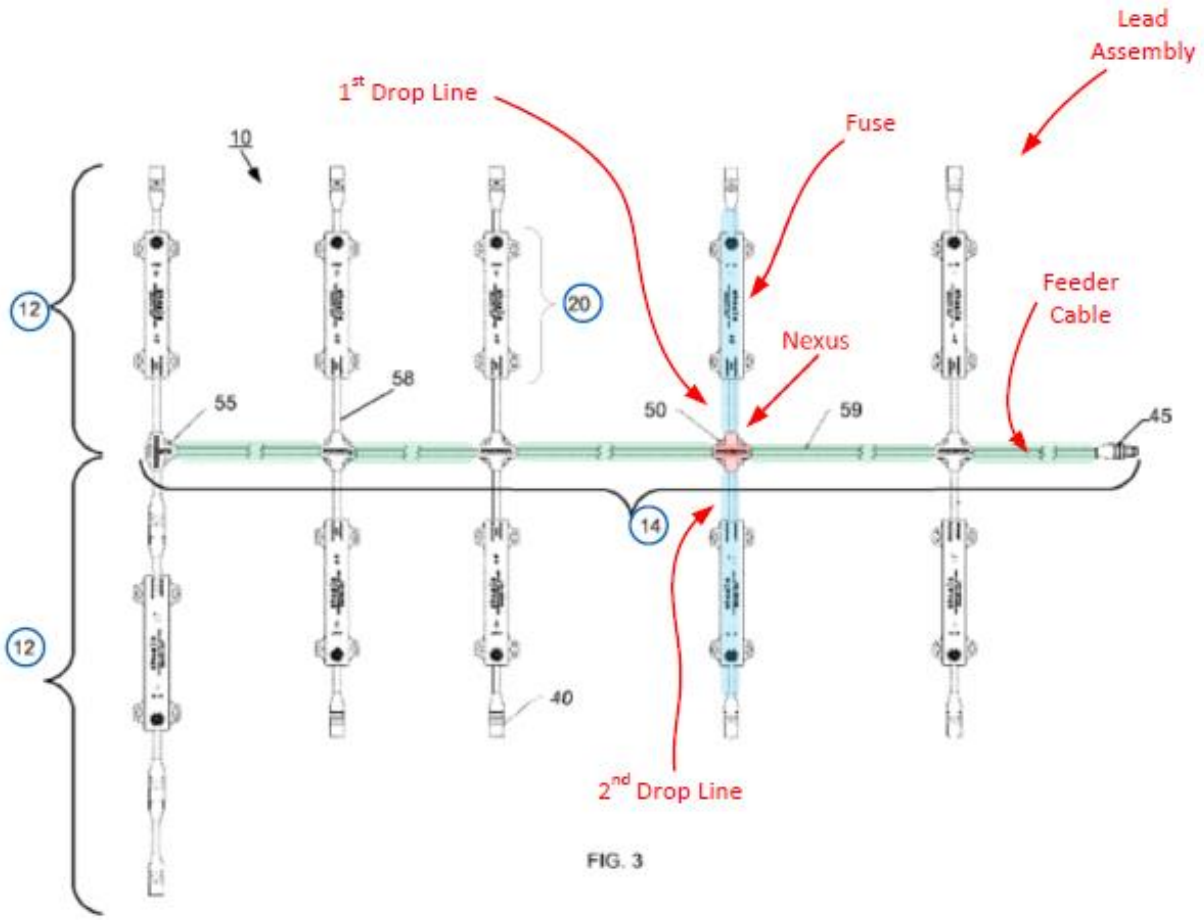


FIG. 3

EX1005, FIG. 3 (2nd-annotation)

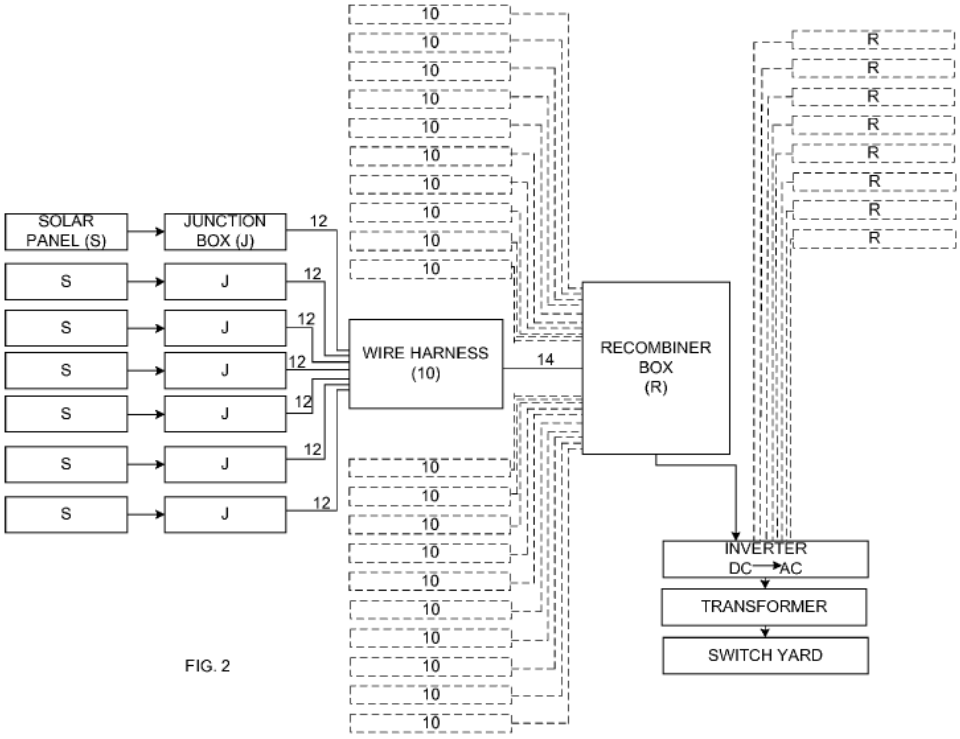
[148] Therefore, a POSITA would have found the limitations in claim 11 to be obvious in view of the Solon741-Yamawaki combination.

6. Claim 12

The lead assembly of claim 1, wherein said lead assembly combines power received from the plurality of solar panels and conducts that power directly to an inverter electrically connected to the feeder cable.

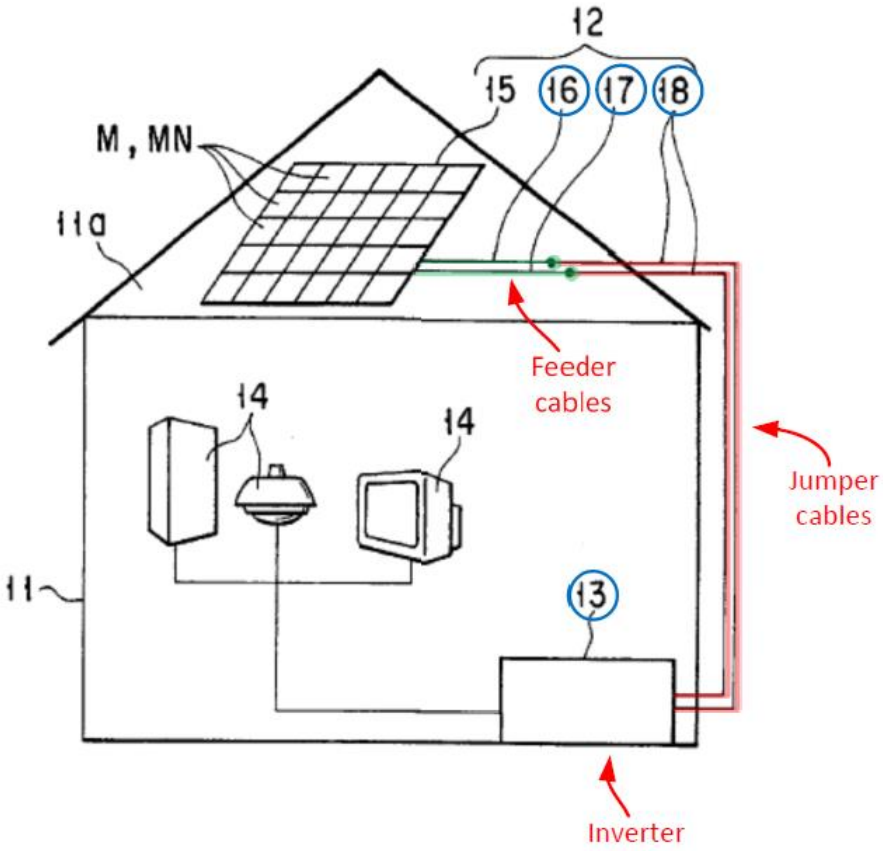
[149] Solon741 discloses a lead assembly (14) for a solar energy installation that combines power received from a plurality of solar panels (S) and conducts the power directly to an inverter electrically connect to the feeder cable (14) as

shown in FIG. 2 below. EX1005, FIG 2.

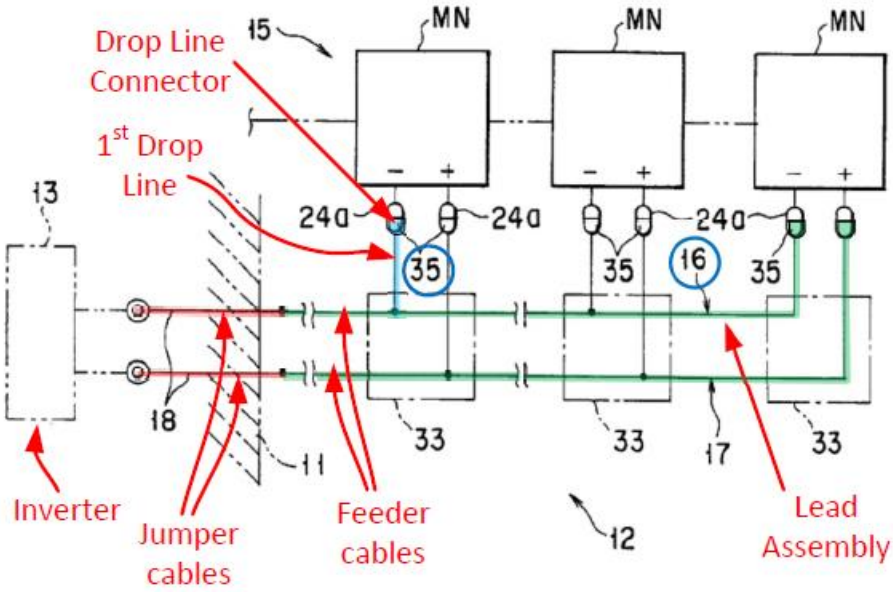


EX1005, FIG. 2

Also, the claim 12 limitations are the same as, at least equivalent to, or encompassed by the claim elements 1(a) and 1(b), and claim 7 that I addressed above. As discussed regarding claim elements 1(a), 1(b), and claim 7, Yamawaki discloses attaching a feeder cable directly to a jumper cable that connects to an inverter as shown in Yamawaki FIGS. 1 and 2. EX1006, 7:45-8:11.



EX1006, FIG. 1 (1st-annotation)



EX1006, FIG. 2 (1st-annotation)

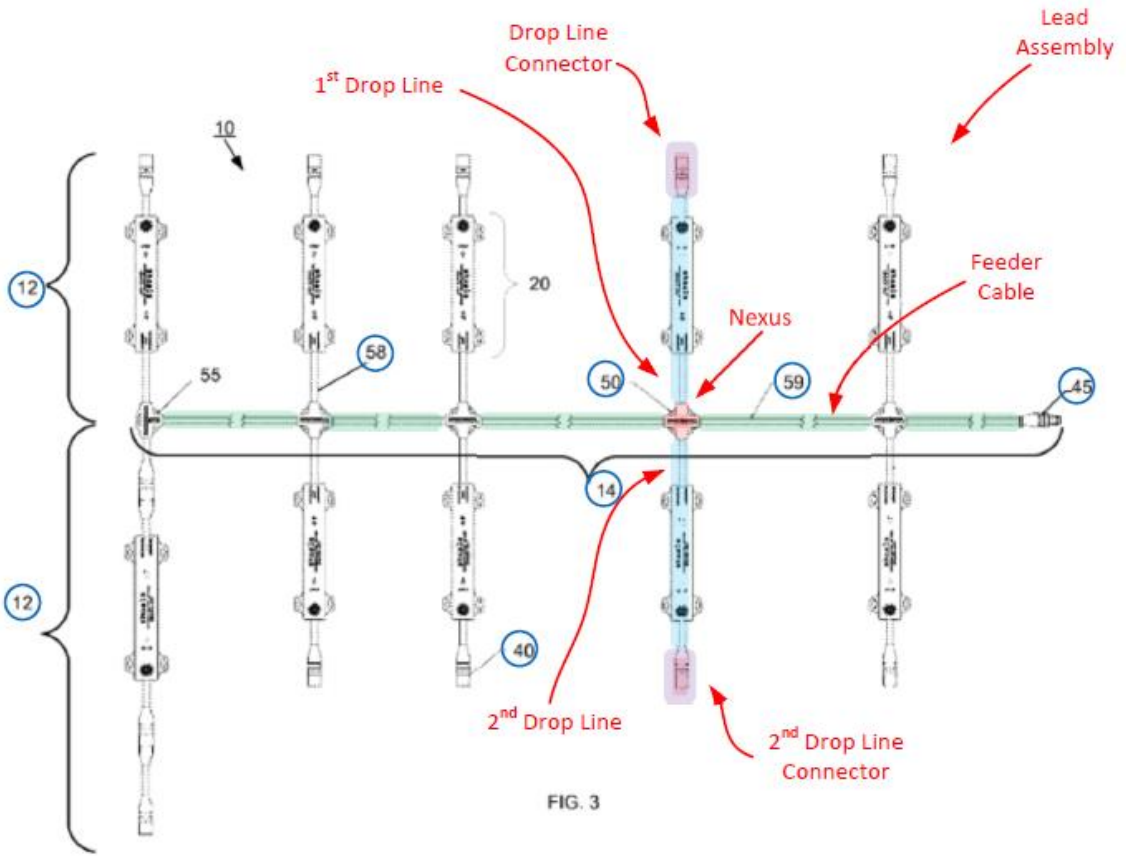
[150] For the reasons presented above regarding the claim elements 1(a) and 1(b),

and claim 7, which I incorporate here by reference, a POSITA would have found the claim 12 limitations to be obvious in view of Solon741 and Yamawaki.

7. Claim 13

The lead assembly of claim 1, wherein the second drop line terminates at a second drop line connector, the second drop line connector configured to connect with a central trunk of a second wire harness, the central trunk of the second wire harness having a plurality of branches the each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of solar panels.

[151] Solon741 discloses, and shows in an illustration reproduced below, that the second drop line terminates at a second drop line connector. *See* EX1005, ¶29 and FIG. 3 (1st-annotation), reproduced below.



EX1005, FIG. 3 (1st-annotation)

[152] As discussed above regarding the first drop line connector being configured to connect to the central trunk of a wire harness (*see* Claim 1(a)), a POSITA would understand that the second drop line connector disclosed by Solon741 is similarly configured to connect with a central trunk of a second wire harness, with the central trunk of the second wire harness having a plurality of branches each of which are configured to electrically connect to a separate solar panel contained in a second array of a plurality of solar panels. *See* EX1005, ¶37 and FIGS. 2 and 3. Additionally, Yamawaki discloses several examples of wire

harnesses coupled to other wire harnesses and cable assemblies for combining the current from solar panels to deliver to a final terminal of the inverter or junction box. *See* EX1006, FIGS. 3 and 5-7. In view of the examples in Yamawaki, a POSITA would recognize that including intermediate wire harnesses can provide a practical and obvious way to combine the current from a collection of panels, and that such intermediate cable assemblies provide a practical and obvious way to combine the current from a collection of wire harnesses for delivery to a final terminal of the inverter or combiner box.

[153] For these reasons, a POSITA would have found the limitations in claim 13 to be obvious in view of the Solon741-Yamawaki combination.

8. Claim 14

The lead assembly of claim 13, wherein the lead assembly is configured to combine electrical power received from the array of solar panels and the second array of solar panels at the *nexus* and to deliver the combined electrical power to an inverter that is in electrical communication with the feeder cable.

[154] The claim 14 limitations are equivalent to the claims 7, 12, and 13 limitations addressed above. For the reasons presented above regarding the claims 7, 12, and 13 limitations, which I incorporate here by reference, a POSITA would have found the claim 14 limitations to be obvious in view of the Solon741-Yamawaki combination.

9. Claim 16

The lead assembly of claim 1, wherein the drop line and the second drop line each includes a wire of between four (4) to eighteen (18) gauge.

[155] Solon741 discloses that the drop lines (i.e., branches 12) may be "constructed of 10 or 12 gauge photovoltaic wire," which a POSITA would understand teaching drop line wires within the recited range of between four and eighteen gauge. *See* EX1005, ¶29.

[156] For this reason, a POSITA would have found the limitations in claim 16 to be obvious in view of Solon741 as part of the Solon741-Yamawaki combination.

10. Claim 17

The lead assembly of claim 16, wherein the feeder cable includes a wire of between 250 MCM to 1000 MCM.

[157] A POSITA would understand that the abbreviation "MCM" stands for "thousands of circular mils," which defines wire sizes. A typical 250 MCM cable has a diameter of more than 1cm, and a 1000 MCM cable has a diameter near 2.5 cm. In view of the standard electrical practices defined in the NEC 2002, a POSITA would understand that an appropriate feeder cable gauge should be selected for the intended use based on the projected current and voltages to be conducted by the feeder cable. *See* EX1010, generally. In particular, a POSITA would understand that the maximum amount of current to be carried by a cable is an important parameter in selection of the cable

diameter and other cable parameters, such as the cable material and the insulation material. Further, the NEC 2002 provides standard guidelines for cable diameter selection based on maximum current, including Table 310.16 titled "Allowable Ampacities of Insulated Conductors Rated 0 Through 2000 Volts..." that is reproduced below. *See* EX1010, p. 149. This ampacity size table with which any POSITA would be familiar lists the gauge of wire that is appropriate for different ampacities of insulated conductors for different types of wires and different temperature ratings. *See id*.

Size AWG or kcmil	Temperature Rating of Conductor (See Table 310.13.)						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18	—	—	14	—	—	—	—
16	—	—	18	—	—	—	—
14*	20	20	25	—	—	—	—
12*	25	25	30	20	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	190	230	255	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000

EX1010, Table 310.16

[158] Table 310.16 (reproduced above) includes ampacity values for cables with 250 or 1000 MCM diameter, showing that cables of these diameters are expected to carry current from 215A to 455A. Other than diameter and current carrying capacity, there are no differences between cables from 18 AWG to 1000MCM. A POSITA would understand how to find and use electrical standards and guides such as the NEC 2002 to make decisions about the diameter of wire needed for different sections of the wiring harness for a solar installation, and to select suitable cables from the catalogs of cable vendors. The NEC 2002 and cable vendor catalogs include similar tables with information for selecting cables for different voltages and resistances. Therefore, a POSITA would understand that the selection of feeder cable size, in the range of 250 MCM to 1000 MCM is an obvious design choice in view of Solon741 and well-known electric codes and standards including the NEC 2002.

[159] For these reasons, a POSITA would have found the limitations in claim 17 to be obvious in view of the Solon741-Yamawaki combination.

11. Claim 21

Preamble. A solar power system comprising:

[160] Solon741 discloses, and illustrates in figures reproduced below, a solar

power system. *See* EX1005, FIG. 2.

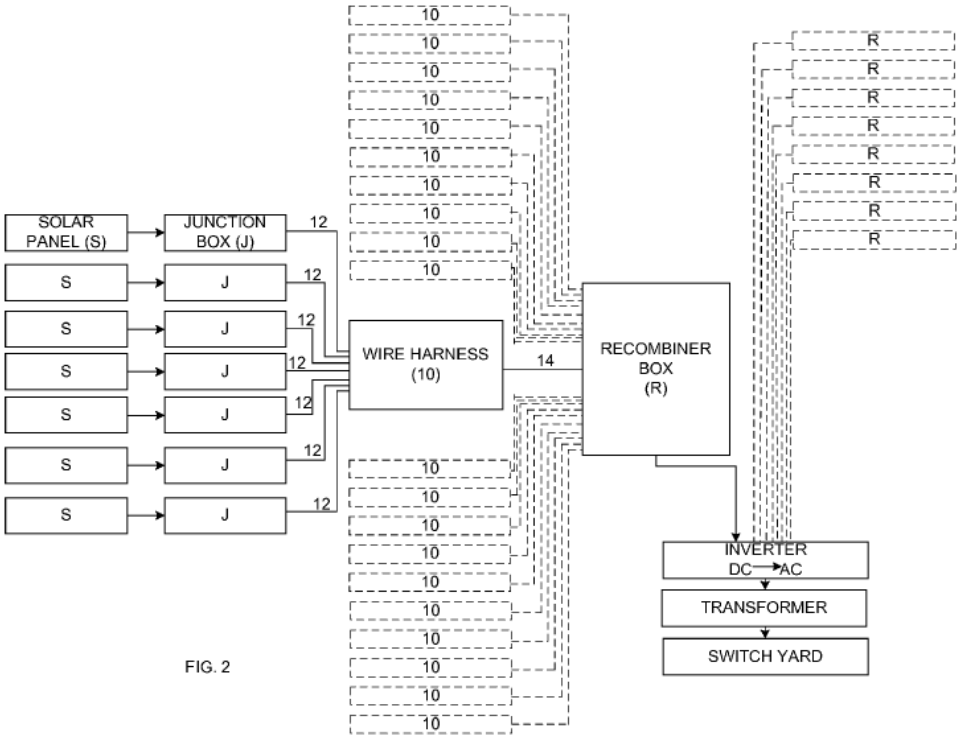


FIG. 2

EX1005, FIG. 2

[161] For this reason, a POSITA would have found the limitation in the preamble of claim 21 to be obvious in view of Solon741.

(a) a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness to form a first solar array;

[162] Solon741 discloses a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness to form a first solar array. *See* EX1005, FIGS. 2 and 3 (combined with 1st-annotation), reproduced above.

[163] For this reason, a POSITA would have found the limitations in claim 21(a)

to be obvious in view of Solon741.

(b) a lead assembly comprising:

[164] The claim 21(b) limitations are equivalent to the claim 1(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b) limitations to be obvious in view of Solon741.

i. a drop line electrically connected to a central trunk of the wire harness and configured to receive power from the plurality of solar panels;

[165] As discussed above with regard to the claim 1(a) limitations, Solon741 in combination with Yamawaki discloses that the drop line connector is connected to a central trunk of a wire harness, and the central trunk of the wire harness inherently has a plurality of branches that each electrically connect to separate solar panels that together are a part of an array of a plurality of solar panels. See my full explanation of the relevant disclosures of Solon741 and Yamawaki in the discussion of the claim 1(a) limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 1(a) limitations, a POSITA would have found the claim 21(b)(i) limitations to be obvious over Solon741 in view of Yamawaki.

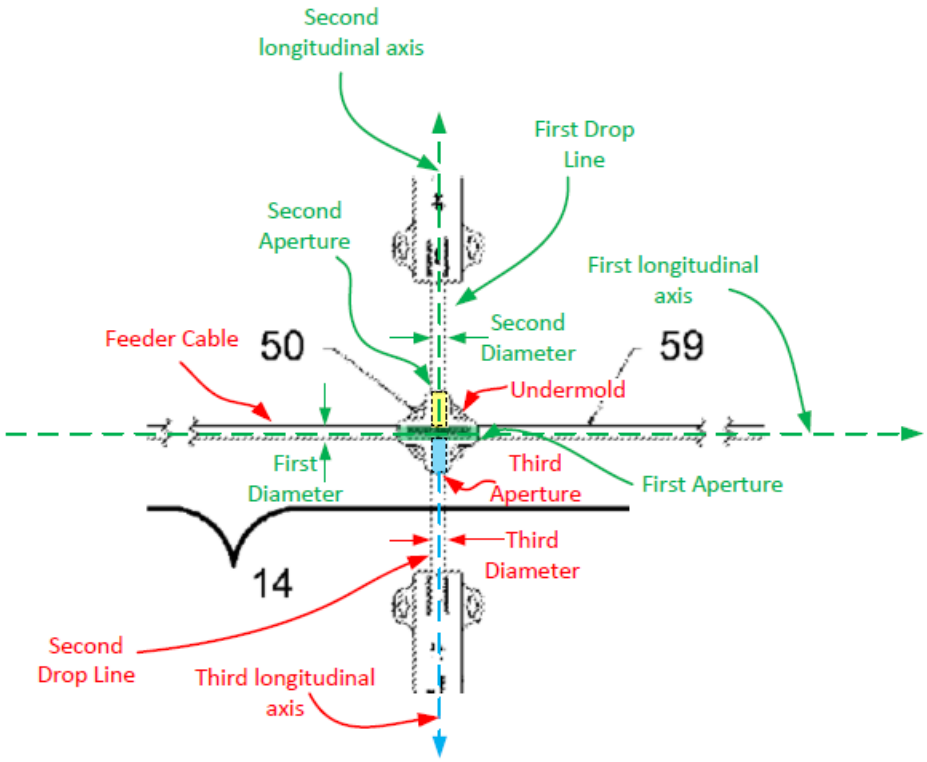
ii. a second drop line electrically connected to a central trunk of a second wire harness and configured to receive power from a plurality of solar panels in a second solar array;

[166] As discussed above with regard to the claim elements 1(c)(iii) and claim 13 limitations, the Solon741-Yamawaki combination discloses a second drop line electrically connected to a central trunk of a second wire harness and configured to receive power from a plurality of solar panels in a second solar array. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim elements 1(c)(iii) and claim 13 limitations, which I incorporate here by reference. For the reasons presented above regarding the claim elements 1(c)(iii) and claim 13 limitations, a POSITA would have found the claim 21(b)(ii) limitations to be obvious in view of the Solon741-Yamawaki combination.

iii. a feeder cable, the feeder cable electrically connected to the drop line and the second drop line at a nexus; and

[167] As discussed above with regard to the limitations of claim elements 1(b) and 1(c)(iii) and claim 18, Solon741 discloses a feeder cable electrically connected to the drop line and the second drop line at a nexus. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim elements 1(b) and 1(c)(iii) and claim 18 limitations, which I incorporate here by reference. In particular, Solon741 shows this limitation in FIG. 3 reproduced below in which the nexus is labeled as

"Undermold".



EX1005, FIG. 3 (Relief and 4th-annotation)

[168] For these reasons, a POSITA would have found the limitations in claim 21(b)(iii) to be obvious in view of Solon741 in the Solon741-Yamawaki combination.

iv. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[169] The specification of the '153 Patent does not define the term "primary mold" or detail about how the primary mold "substantially seals" the nexus because no description of a sealing function of the primary mold or undermold was

included in the original disclosure. *See* EX1001, generally. Based on illustrations in the '153 Patent and the plain and ordinary meaning of the expression "primary mold" in the context of the claim, it is my opinion that a POSITA would have understood the term "primary mold" in the '153 Patent claims to mean a " material molded over a piece or part that seals against environmental factors." *See* EX1001, FIGS. 48, 54, 55, 60 and generally. This definition is consistent with a definition adopted by the Order in the parallel proceedings before the International Trade Commission involving the '153 Patent. *See* EX1017, p.36. That construction is informative for establishing how a POSITA would understand the terms in the context of the '153 Patent claims.

[170] In view of this understanding of these claim terms, the claim 21(b)(iv) limitations are equivalent to the claim 1(c) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(c) limitations, which I incorporate here by reference. For the reasons presented in the claim 1(c) limitations, a POSITA would have found the claim 21(b)(iv) limitations to be obvious in view the Solon741-Yamawaki combination.

(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture;

(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture and

(3) a third aperture extending partially through the primary mold and having a third diameter smaller than the first diameter, wherein the second drop line extends into the third aperture.

[171] The claim 21(b)(iv)(1-3) limitations are equivalent to the claim 1(c)(i)-(iii) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(c)(i)-(iii) limitations, which I incorporate here by reference. Although the claim elements 21(b)(iv)(2) and 21(b)(iv)(3) refer to "smaller" diameters, in contrast to claim elements 1(c)(ii) and 1(c)(iii), which refer to "different" diameters, reciting that two apertures have different diameters implies a comparison where one aperture must necessarily have a smaller diameter than the other. For these reasons and the ones presented regarding the claim 1(c)(i)-(iii) limitations, a POSITA would have found the claim 21(b)(iv)(1-3) limitations to be obvious in view of the Solon741-Yamawaki combination.

12. Claim 22

The solar power system of claim 21, wherein the feeder cable is directly electrically connected to a component selected from the group consisting of a trunk buss jumper, an inverter, a connection unit, a recombiner, and a disconnect unit.

[172] The claim 22 limitations are the same as or at least equivalent to the claim 6, claim 12, and claim 14 limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 6, 12 and 14 limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 6, claim 12, and claim 14 limitations, a POSITA would have found the claim 22 limitations to be obvious in view of Solon741 and Yamawaki.

13. Claim 23

The solar power system of claim 21, further comprising a secondary mold surrounding the primary mold and forming an undermold-overmold interface at an outer surface of the primary mold.

[173] The claim 23 limitations are equivalent to the claim 1(d) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(d) limitations, which I incorporate here by reference. For the reasons presented above for the claim 1(d) limitations, a POSITA would have found the claim 23 limitations to be obvious in view of the Solon741-Yamawaki combination.

14. Claim 24

Preamble. A solar power system comprising:

[174] The claim 24(Preamble) limitation is the same as the claim 1(Preamble) or claim 21(Preamble) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(Preamble) and claim 21(Preamble) limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 1(Preamble) or claim 21(Preamble) limitations, a POSITA would have found the claim 24(Preamble) limitations to be obvious in view of Solon741.

a. a plurality of solar panels electrically coupled by a wire harness to form a first solar array;

[175] The claim 24(a) limitations are equivalent to the claim 21(a) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 21(a) limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 21(a) limitations, a POSITA would have found the claim 24(a) limitations to be obvious in view of Solon741.

b. a lead assembly comprising:

[176] The claim 24(b) limitations are equivalent to the claim 1(Preamble) or claim 21(b) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(Preamble) and claim 21(b) limitations, which I incorporate here by

reference. For the reasons presented above regarding the claim 1(Preamble) and/or claim 21(b) limitations, a POSITA would have found the claim 24(b) limitations to be obvious in view of Solon741.

i. a first drop line electrically connected to the wire harness and configured to receive power from the plurality of solar panels;

[177] The claim 24(b)(i) limitations are equivalent to the claim element 1(a) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim element 1(a) limitations, which I incorporate here by reference. For the reasons presented above regarding the claim element 1(a) limitations, a POSITA would have found the claim 24(b)(i) limitations to be obvious in view of the Solon741-Yamawaki combination.

ii. a feeder cable, the feeder cable electrically connected to the drop line at a nexus;

[178] The claim 24(b)(ii) limitations are the same as or at least equivalent to the claim element 1(b) or claim 18 limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim element 1(b) or claim 18 limitations, which I incorporate here by reference. For the reasons presented above regarding the claim element 1(b) or claim 18 limitations, a POSITA would have found the claim 24(b)(ii) limitations to be obvious in view of Solon741.

iii. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[179] The claim 24(b)(iii) limitations are the same as or at least equivalent to the claim 1(c) or claim 18 limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(c) and 18 limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 1(c) and/or claim 18 limitations, a POSITA would have found the claim 24(b)(iii) limitations to be obvious in view of the Solon741-Yamawaki combination.

(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis;

[180] The claim 24(b)(iii)(1) limitations are the same as or at least equivalent to the claim 1(c)(i) or claim 21(b)(iv)(1) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(c)(i) and 21(b)(iv)(1) limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 1(c)(i) or claim 21(b)(iv)(1) limitations, a POSITA would have found the claim 24(b)(iii)(1) limitations to be obvious in view of the Solon741-Yamawaki combination.

(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture along a second longitudinal axis; and

[181] The claim 24(b)(iii)(2) limitations are the same as or at least equivalent to the claim 1(c)(ii) or claim 21(b)(iv)(2) limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 1(c)(ii) and 21(b)(iv)(2) limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 1(c)(ii) or claim 21(b)(iv)(2) limitations, a POSITA would have found the claim 24(b)(iii)(2) limitations to be obvious in view of the Solon741-Yamawaki combination.

iv. a second drop line electrically connected to a second wire harness that connects to a plurality of solar panels, the second drop line electrically connected to the feeder cable at the nexus fully encased by the primary mold, wherein the second drop line extends into a third aperture defined by the primary mold along a third axis.

[182] The claim 24(b)(iv) limitations are the same as or at least equivalent to the claim 13 limitations addressed above. See my full explanation of the relevant disclosures of the Solon741-Yamawaki combination in the discussion of the claim 13 limitations, which I incorporate here by reference. For the reasons presented above regarding the claim 13 limitations, a POSITA would have found the claim 24(b)(iv) limitations to be obvious in view of the Solon741-

Yamawaki combination.

[183] In sum, for all of the reasons discussed above regarding Ground 1, it is my opinion that a POSITA would have found claims 1, 5-7, 11-14, 16, 17, and 21-24 to be obvious in view of the Solon741-Yamawaki combination, and therefore should be found invalid under 35 U.S.C. § 103 based on Solon741 and Yamawaki.

B. Ground 2: Claims 1-3, 5-19, and 21-24 are unpatentable under 35 U.S.C. § 103 as obvious in view of Amphenol, Shao, and Yamawaki.

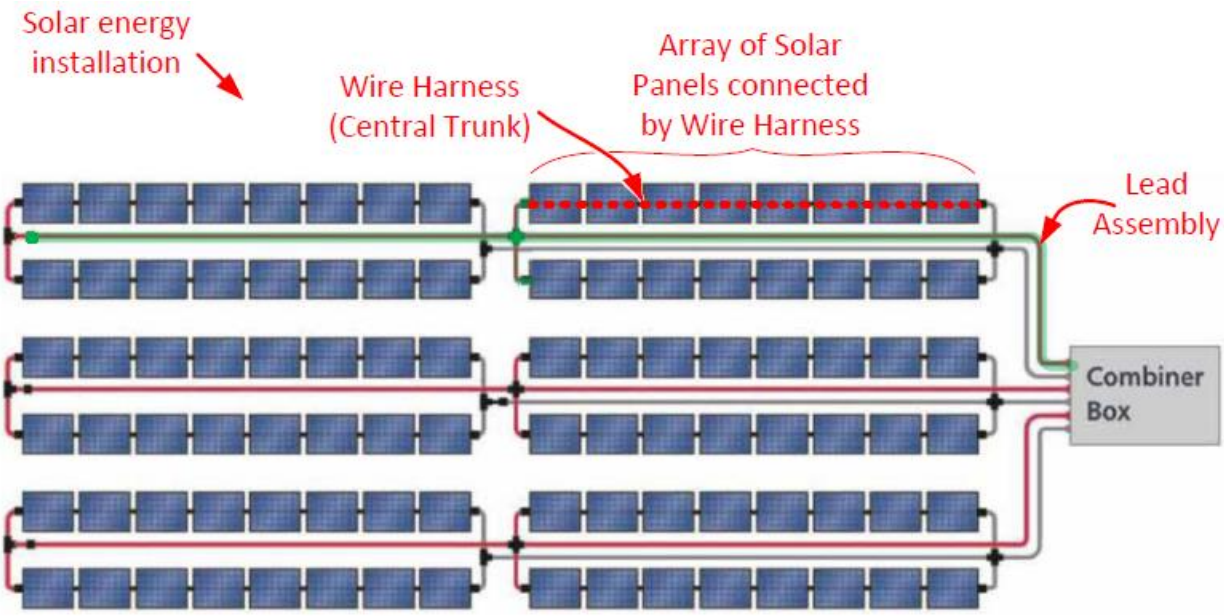
i. Motivation to Combine Amphenol and Shao

[184] A POSITA would have been aware of Amphenol and Shao (i.e., the "Amphenol-Shao combination") because both references address the general problem of providing convenient, flexible, reliable, and low-cost wiring harnesses for power applications. Amphenol is concerned with wire assemblies, cable junctions, connectors, in-line fuses, and other components to be used for combining and distributing power from elements of a solar array installation. See EX1007, generally. Shao is also concerned with the field of wires (i.e., cables) and more specifically the detailed design of a cable junction to be used for power distribution. See EX1008, generally. These references discuss the design of cable junction elements that can be used to combine or distribute electrical power. The important details disclosed in Amphenol and

Shao relate to the formation of a reliable electrical contact between different cables, protecting the connection from environmental factors and damage from handling, and fabricating the electrical contact elements in a way that reduces cost and simplifies the assembly and maintenance of the power facilities. Amphenol focuses on solar arrays, and Shao is focused on power distribution, but the underlying mechanics, materials, assembly processes, molding processes, and other details are similar such that a POSITA would have been motivated to consider both publications in combination. Fundamentally, within a cable junction, the biggest difference between power combining and power distribution is the direction in which that electrons are moving in some parts of the junction. Based on well-known practices in the field of solar power systems, such as taught in the PSE textbook (EX1011) and the NEC 2002 (EX1010), a POSITA would understand how to apply the teaching of Shao to the wiring assembly disclosed by Amphenol to produce systems suitable for solar power systems with the benefits sought in both references.

[185] Amphenol is a product catalog representing a broad array of electrical products that can be used to make electrical connections or junctions between cables and other elements in an electrical system. The catalog states "Amphenol designs, manufactures and markets electrical, electronic and fiber optic connectors, interconnect systems, and coaxial and specialty cables…and

provides solutions for customers in the automotive, broadband, industrial, information technology and data communications, military and aerospace, mobile devices and mobile networks markets." EX1007, p. 2. This includes cables, cable assemblies, and other elements specifically for solar installations. *See id.*, pp. 2-16, middle image (1st-annotation), reproduced below.



EX1007, p. 5, middle image (1st-annotation)

[186] Amphenol specifically illustrates and provides specifications for cable installations for solar cell arrays including solar panels, wiring harnesses, and lead assemblies each with a feeder cable, drop lines, and connectors. *See id., e.g.*, pp. 3-13. In Amphenol, the lead assemblies are referred to as "junction cable assemblies," and a variety of such assemblies are disclosed. *e.g.*, pp. 5 and 13. Each of the variety of disclosed junction cable assemblies address the

general problem of providing convenient, flexible, reliable, and low-cost wiring connections for solar cell installations. *See id.*, p. 21, top image. Also, in Amphenol, the lead assemblies include a feeder cable, which is referred to as a "main cable," and drop lines, which are referred to as "branch cables." *See id*., p. 21, generally. From well-known practices in the field of solar power systems (e.g., EX1010) and illustrations in Amphenol (e.g., EX1007, p. 5, middle image reproduced above), a POSITA would understand that a solar power installation includes a number of individual solar panels and a set of cables that connect the solar panels to a common terminal at the inverter, and that this set of cables would include wiring assemblies that provide a convenient conductive structure for making electrical connections with individual solar panels in large solar power installations. Also, from well-known practices in the field of solar power systems, a POSITA would understand that such cables need to be joined together at a single terminal to the inverter or alternatively be brought together at an intermediate combiner box (*e.g.,* EX1010, Figure 690.1(B), p. 544).

[187] Although the '153 Patent uses particular terminology for various elements of its wiring assemblies (e.g., "lead assembly," "feeder cable," drop line," and "wire harness"), a POSITA at the time the '153 Patent was filed would understand that such terminology is not universal within the industry. For example, neither the NEC 2002 nor the PSE textbook uses these terms. *See*

EX1010, Article 690, pp. 543-552 and EX1011, generally. A POSITA familiar with the design of solar power systems and the selection of suitable electrical wiring and connectors (e.g., EX1010, 690.8 Circuit Sizing and Current, p. 546), including photovoltaic wiring and connectors, would understand that the terms "wire harnesses" and "lead assemblies" both refer to wiring assemblies used for organizing and facilitating electrical connections within electrical power systems. See paragraphs [0089]-[0093] above for further discussion on these terms in the art. A POSITA familiar with the design of solar power systems and the selection of suitable electrical wiring and connectors (e.g., EX1010) would understand that the roles of "wire harnesses" and "lead assemblies" differ between devices used for power combining or power distribution, but the materials and dimensions of their construction are the same and/or analogous. The distinctions in the role played by these cable assemblies do not change the materials and dimensions of wiring assemblies used in power gathering or power distribution systems. For example, the Yamawaki reference, which like the '153 Patent relates to photovoltaic generation wiring and systems, uses the terms "wiring apparatus," "trunk cable," "branch cable," and "branch junctions," for electricity conducting elements that the '153 Patent calls the "lead assembly," "feeder cable," "drop line," and "joint," respectively. *See* EX1006, 9:57-10:19. Similarly, the Solon741 reference (which has the same

inventor as the ’153 Patent), which like the ’153 Patent relates to photovoltaic generation wiring and systems, uses the terms “wire harness,” “trunk,” “branch,” and “cross joints,” for electricity conducting elements that the ’153 Patent calls the “lead assembly,” “feeder cable,” “drop line,” and “joint,” respectively. *See* EX1005, ¶29.

[188] Despite the variations in terminology commonly used in the field of photovoltaic power systems, a POSITA would appreciate that the basic electrical wiring and connector elements perform similar functions and have similar requirements. Solar power electrical wiring and connector assemblies all include junctions between cables, and serve to merge or divide current from a power generation system or a power distribution system. For example, the lowest voltage wires may feed or drop into a larger connecting line that carries the higher voltage to another larger line that receives voltage from multiple connecting lines. Accordingly, a POSITA familiar with the design of solar power systems (e.g., EX1010 and EX1011) would have understood that the solar array includes a hierarchy of branches where the wires and connections can have different names despite operating in the same manner in the same hierarchy.

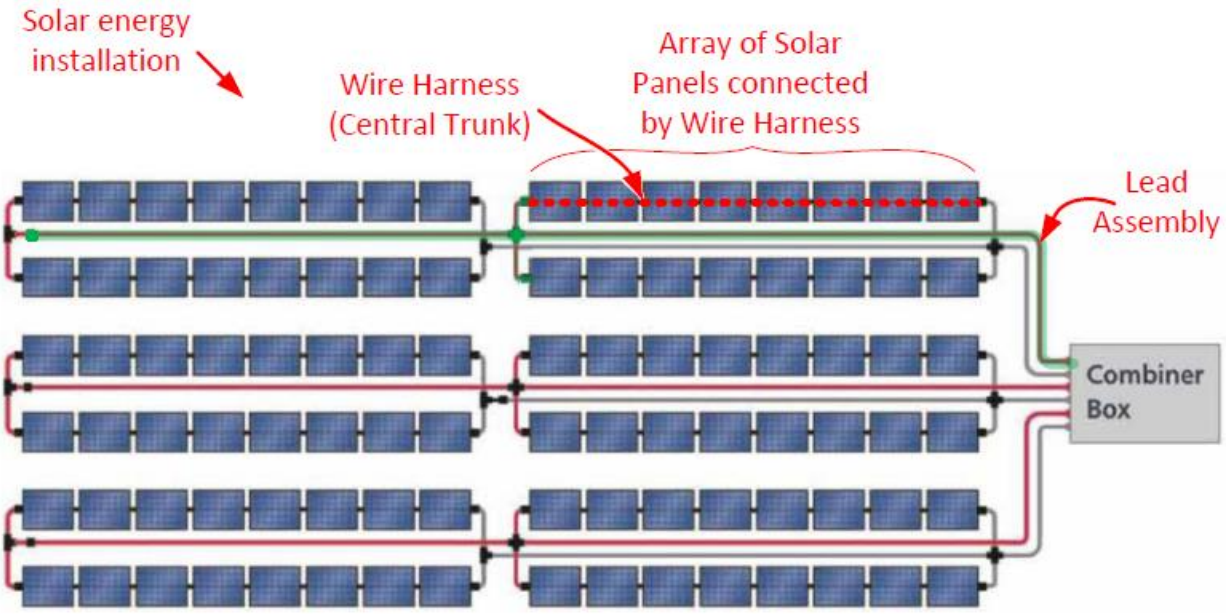
[189] A POSITA familiar with the design of solar power systems (e.g., EX1010 and EX1011) would have understood that main cables supplying power and

carrying higher currents may be called “trunks,” “trunk cables,” “trunk conductors,” “main cables,” “feeder cables,” or the like. Similarly, the smaller diameter cables branching off a main cable and carrying lower currents may be called “branches,” “branch cables,” “branch conductors,” “branch lines,” “drop lines,” or the like. Also, wiring assemblies that join electrical components and/or wires may be called “wire harnesses,” “lead assemblies,” “wiring apparatus,” or the like depending upon local and/or regional parlance. A POSITA would understand that the only significant difference between cable junctions used for merging or dividing current flow is the direction of the current flows into or out of the junctions. With knowledge of the NEC 2002, a POSITA would have understood that it is important to use appropriately sized cables for the intended application, have very good electrical connections within these junctions, and provide protective moldings to prevent the effects of external environments from causing corrosion or failure of the cables and junctions.

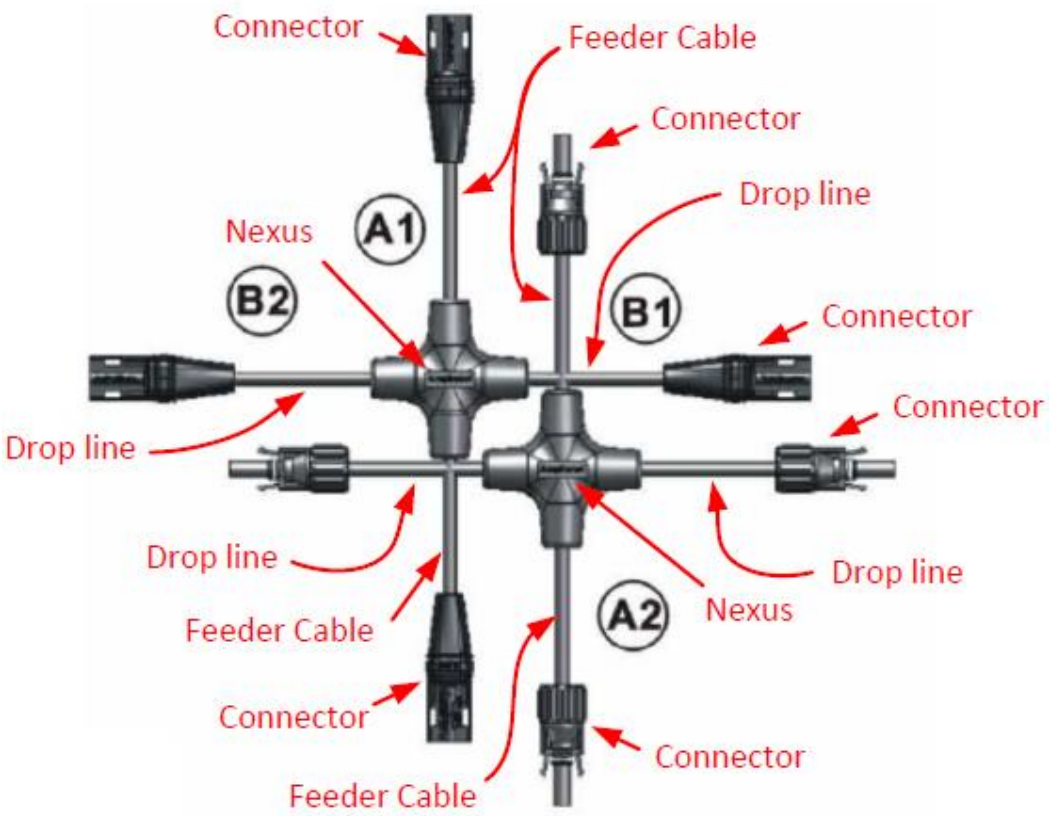
[190] A POSITA familiar with the design of solar power systems (e.g., EX1010 and EX1011) would further understand that a combiner box is one example of a convenient means for merging current from several lead assemblies to a single cable that is applied to the terminal of the inverter. Such a POSITA would also understand that the cable assemblies may be arranged so that all of the currents

from some or all of the solar panels in the installation are brought together through a series of junctions and or branch structures to a single cable that can be applied to the terminal of the inverter without need for a combiner box. For example, Yamawaki demonstrates this in various illustrated schematic drawings disclosed therein. *See* EX1006, FIGS. 2-7.

[191] An illustration of an example solar power system from the Amphenol brochure is reproduced below, with annotations, showing the arrangement of solar panels, wire harnesses, and lead assemblies that gather the electrical power from the solar panels and delivers the electrical power to a combiner box.



EX1007, p. 5, middle image (1st-annotation)



EX1007, p. 13, bottom image (1st-annotation)

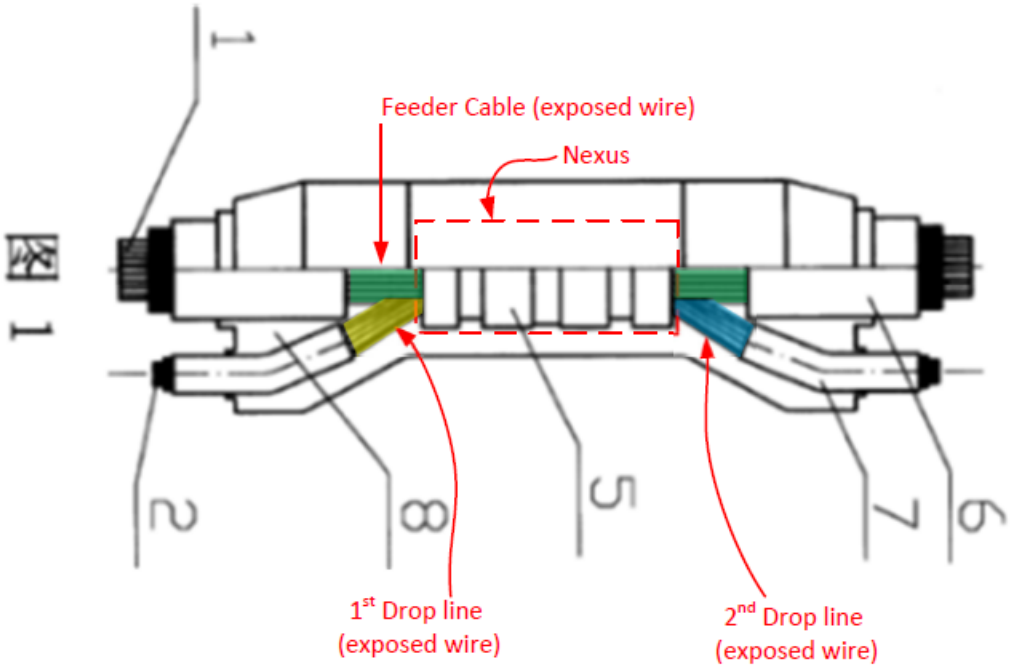
[192] Also, as illustrated above, Amphenol provides examples of a variety of junction cable assembly elements that a POSITA would understand can be selected to match the design of a solar array installation. These assemblies include wires, insulation, and molded housings at the junctions that provide protection from corrosion or failure in the field during use. *See id.*, p. 13, bottom image (1st-annotation).

[193] Shao is Chinese patent CN 2785100, published May 31, 2006. *See* EX1008, cover page. This patent relates to power cables with bidirectional K-shaped branches for power distribution. *See id.*, Abstract. Shao particularly discloses a

K-shaped branch connector structure that:

> A K-shaped branch structure can enable single-branch-joint double-branch power distribution. The branch lines are led out in an upper direction and a lower direction of the branch joint, respectively and can be led to two floor power distribution boxes, respectively. The branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear.

See EX1008, Abstract and FIG. 1 (1st annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

[194] Shao describes details of construction of a k-branch connector which combines a bi-directional feeder cable with a pair of branch cables to provide an element of a cable harness for use in power distribution. *See* EX1008, Abstract. "One trunk conductor and two branch-line conductors are symmetrically overlapped and crimped by means of the K-shaped branch connector 5 to form

one joint and two branch-line conductor out-leads, and directions of the branch-line conductor out-leads are opposite." *Id*., 6:18-22. "A K-shaped branch connector outer sheath 8 is made of an injection molding material of injection molding grade, and a trunk outer sheath 6 and branch-line outer sheaths 7 are made of polyvinyl chloride, polyethylene or low-smoke zero-halogen polyolefin, ensuring that the connector outer sheath and the cable outer sheath are similar in the terms of material and are tightly combined," *Id*., 6:24-30. "The bidirectionally led branch lines are a whole cable, so that the workload of peeling the cable during production can be decreased, the branch connection reliability of the branch lines can also be improved, and the service life of the branch joint can be prolonged." *Id*., 5:31-34. Therefore, Shao is analogous prior art to the '153 patent, since it is in the same field of endeavor of power connectors, and is directed to solving the same problems as the '153 patent.

[195] Amphenol and Shao are not cumulative references because Amphenol focuses on cable assemblies, connectors, tools, and accessories and Shao addresses the details of the cable junctions. Key elements in Amphenol, Shao, and all the other prior art references cited herein, relate to the fact that cable junctions are used to manage the gathering and/or distribution of power, particularly where a larger-diameter cable is joined to one or more smaller diameter cables. More importantly, a POSITA would understand that the

benefits of design elements and materials choices for any of these cable junctions are likely to apply to all of these junctions, as all of these elements are concerned with electrical system installations which rely on intersections between cables carrying small currents and large currents, used in situations that benefit from reliability, resistance to environmental factors, simplicity in installation, and maintenance and low cost.

[196] As discussed above, the fundamental requirements for cable junctions to be used for combining current in a solar array cable harness and for distributing current in a power distribution cable harness are the same, and that elements of the design of the K-shaped branch connector in Shao would be considered by a POSITA interested in improvements to the cable junctions disclosed by Amphenol.

[197] A POSITA would understand that the solar power system connectors disclosed by Amphenol could be designed and manufactured using the materials, design, and processes disclosed by Shao. For example, the details associated with overlapping and crimping the cable and drop lines using an extended copper C-shaped clamp within the assembly of Shao, which ensures electrical contact (i.e., conductivity) and structural joining of the feeder cable to the drop lines, would have been appreciated as an advantageous approach for the construction of solar power system elements disclosed by Amphenol.

Additionally, Shao discloses using insulation layers and injection molding to form the packaging around the nexus of the cables, which would provide protection from external environmental factors such as would be important for the installation of solar power system components of Amphenol. The wire assembly designs disclosed by Amphenol (*see* Figures on pages 5 and 21 from Amphenol, above) would obviously benefit from the features disclosed by Shao, as related to the design and manufacture of the K-shaped branch structure shown in FIG. 1 from Shao, which provide "good insulation performance, heat resistance stability and overheating aging performance." *Id.*, 6:40-7:1. Although the K-shaped connector disclosed in Shao is described in the context of building construction, a POSITA in the field of solar power systems would consider a wide range of electrical connector designs that can withstand environmental conditions, like extreme moisture, as well as resist tension loads from forces (e.g., wind) acting on cables, which is what is needed for solar installations. *See id.*, 5:25-27. The extended copper C-shaped clamp (5) in the Shao's K-shaped connector provides both an electrical and mechanical joint, resulting in a robust physical connection of the drop lines to the main that can prevent droplines from being pulled out of the connector under tension loads. *See id.* Shao also emphasizes the importance of connection reliability, a low-profile design that occupies a small mounting space, and eliminating extra

branch joins, as well as moisture and water proofing that would also be important for the solar power installations of Amphenol. *See id.*, 5:27-31,37-40. A POSITA would consider the use of details provided by Shao to form the branch elements in the broader variety of cable assemblies disclosed by Amphenol in order to capture the features and benefits of the Shao junctions throughout the harnesses of Amphenol. In particular, the details in Shao associated with overlapping and crimping the cable and drop lines within the assembly and using insulation layers and injection molding to form the packaging around the nexus of the cables would be understood to provide a concise installation with increased service life. *See id.*, 6:18-30.

[198] Stated more directly, Amphenol discloses solar power system components that are obviously intended for use in outdoor settings, because outdoors is where the sunlight is available for capture and conversion to energy. Installations such as those disclosed in Amphenol are obviously intended for reliable capture and conversion of sunlight for years of use because reliable operation, over extended periods, is required because years of use are needed to create enough economic benefit to overcome the cost of the initial installation. A POSITA tasked with designing or assembling wiring components of a solar power installation would be interested in any disclosures that could provide improvements in reliability, flexibility, structural integrity, and cost of the

components of the installation. Specifically, a POSITA would appreciate that the cables, connectors, and junctions disclosed in Amphenol can be improved by incorporation of details from a reference such as Shao, as the basic characteristics of cable junctions in Amphenol and Shao are the same. Specifically, the detailed description of overlapping and crimping cables, and the formation of insulation and protection by injection molding from the power distribution k-shaped branch connector of Shao would be understood by a POSITA to provide a more robust connection with the benefits of improved reliability and simplicity if used for the assembly of at least some of the cable junctions of Amphenol for solar power combining applications.

[199] Additionally, a POSITA would consider replacement or addition of the connectors in the wire assembly of Amphenol with the K-shaped branch connectors disclosed by Shao for providing additional branches at each junction while minimizing connectors needed to do so, and for addressing the reliability and performance benefits disclosed in the abstract of Shao, including:

> The branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear. The bidirectionally led branch lines are a whole cable, so that the workload of peeling the cable during production can be decreased, the branch connection reliability of the branch lines can also be improved, the service life of the branch joint can be prolonged, and the power cable has a very good popularization and application value.

EX1008, Abstract.

[200] Also, a POSITA would have an expectation of success in combining Amphenol and Shao since Shao complements the disclosure of Amphenol by disclosing design and materials that are appropriate choices for these junctions while also providing alternative connector configurations and advantages thereof. A POSITA that selects components for a solar energy installation and performs the installation would be familiar with the families of components, wire harnesses and lead assemblies disclosed in Amphenol, and would appreciate the benefits of the details provided by Shao in design and manufacturing of reliable and easily utilized branch structures. Further, the K-shaped branch connectors disclosed by Shao could be spliced into cables and wire harnesses of Amphenol using the assembly processes taught in Shao as well as ordinary electrical practices.

[201] For these reasons, a POSITA would be motivated to combine the teachings of Amphenol and Shao because the wire harnesses, lead assemblies and solar photovoltaic power generation systems disclosed by Amphenol are intended for use in a harsh outdoor environment and would benefit from added protection from the elements and improved reliability for the branch structures provided by the more robust design and manufacturing processes for the connectors disclosed in Shao.

ii. Motivation to Combine Amphenol, Shao, and Yamawaki

[202] A POSITA would have been motivated to combine the teachings of Amphenol and Shao with those of Yamawaki (i.e., the "Amphenol-Shao-Yamawaki combination") for the reasons set forth below.

[203] As discussed above, the Amphenol-Shao combination discloses an enhanced lead assembly with a compact protective insulating case that may be used in a solar energy installation. The disclosure of the first embodiment of Yamawaki is discussed in more detail above regarding the Solon741-Yamawaki combination. *See* 'A(i) Motivation to Combine Solon741 and Yamawaki,' discussed above. Similar to Amphenol, in combination with Shao, Yamawaki discloses cable assemblies with branch junctions. Like Amphenol, Yamawaki discloses photovoltaic modules that may be arranged in various ways to overcome challenges and support the design of a photovoltaic panel array, such as on a home solar energy installation. *See* EX1006, 7:54-8:11. Within this disclosure, Yamawaki demonstrates that the feeder wire of a wire harness may be connected to an inverter, such as via another cable. *See id*. and FIGS. 4-6, which are reproduced herein. Thus, Yamawaki complements the Amphenol-Shao combination by teaching that the structure of photovoltaic power connectors may be directly connected to an inverter. Yamawaki discloses that it was known to include wire harnesses coupled to other wire harnesses and

cable assemblies for combining the current from solar panels to deliver to a common connection point, such as the inverter or junction box. *See id.*, FIGS. 3-7. Also, like Amphenol, Yamawaki is directly analogous to the '153 Patent because it is directed to solar power wiring assemblies like the ones claimed in the '153 Patent.

[204] Amphenol discloses a variety of cable junction geometries allowing users to select combinations for wire harnesses and cable assemblies that are appropriate for their system configuration. Shao discloses a connection arrangement that can be used for joining the main cables and drop lines and providing insulation and molding to protect the junctions. Yamawaki provides further improvements to branch junctions that include a molded body (i.e., an undermold) covered by a cover member (i.e., an overmold). *See id*., 10:19-22 and FIG. 9B. In addition, Yamawaki discloses that such branch junctions provide water-resistance and improved reliability. *See id*., 13:15-18. A POSITA would be motivated to combine the teachings of Amphenol, Shao, and Yamawaki, specifically the addition of the overmold, in the form of a cover member, over an undermold to achieve further improvements in reliability and performance such as the "water-resistance" as described by Yamawaki. Further, a POSITA would have been motivated to use these detailed junction designs, processes, and materials of Shao and Yamawaki, to build the entire catalog of

wiring harness components disclosed by Amphenol.

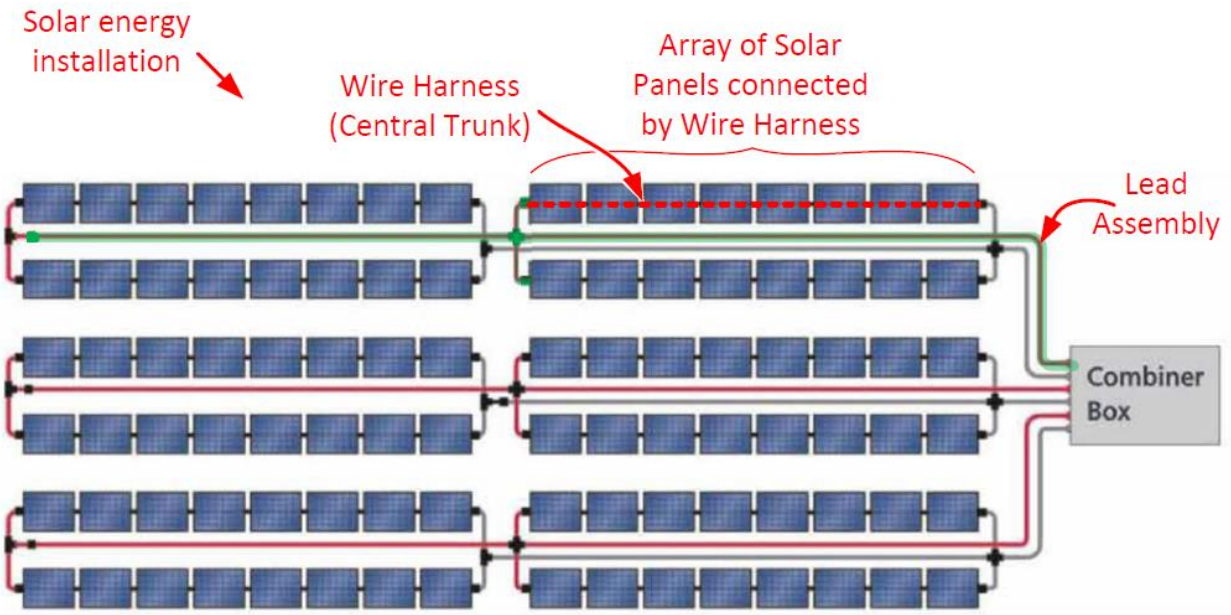
[205] Although Yamawaki, like Amphenol and Shao, does not explicitly refer to the cables and wiring assemblies as "drop lines," "a feeder cable," "lead assembly," "a wire harness," or "a central trunk," as discussed above, a POSITA would understand that the disclosed cables and wiring assemblies correspond to and/or analogous to drop lines, a feeder cable, a lead assembly, a wire harness, and/or a central trunk. *See* 'C(i) Motivation to Combine Amphenol and Shao,' discussed above.

[206] A POSITA would have had an expectation of success in combining the Amphenol-Shao combination with that of Yamawaki because the photovoltaic modules and wiring junctions in Yamawaki are intended for use with solar installations based on standard solar panels that generate similar current and voltage outputs to those disclosed in the Amphenol-Shao combination. Therefore, a POSITA would expect the electrical and mechanical requirements to be similar. Also, Amphenol, Shao, and Yamawaki are not cumulative because Amphenol relates to on cable assemblies, connectors, tools, and accessories, Shao gives the details of the cable junctions, and Yamawaki covers the different and broader aspects of solar power installations.

1. Claim 1

Preamble. A lead assembly for use in a solar energy installation including:

[207] Amphenol discloses and shows in an illustration a lead assembly (annotated in green below) for use in a solar energy installation. *See* EX1007, p. 5, middle image (1st-annotation), reproduced below.



EX1007, p. 5, middle image (1st-annotation)

[208] A POSITA would understand that a solar power installation of Amphenol includes a number of individual solar panels and a set of cables that connect the solar panels to a common terminal of an inverter. That set of cables would include one or more wire harnesses that provide a convenient structure for making connections to and between the individual solar panels. In addition to the wire harness(es) connecting series of solar panels, the set of cables would

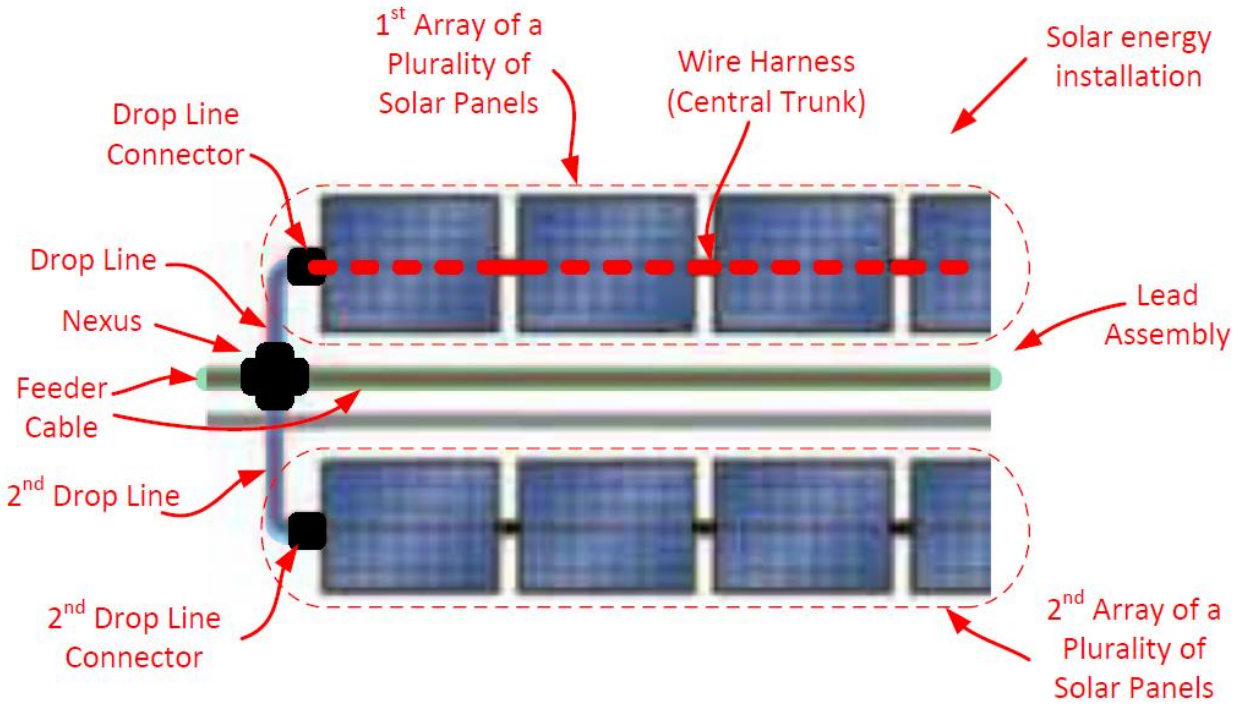
also include lead assemblies that are connected to the wire harnesses and come together at a single terminal of the inverter, a combiner box, or other junction. An illustration of such a system from the Amphenol brochure is provided above, with annotations, showing the arrangement of solar panels, wire harnesses, and lead assemblies that gather the electrical power from the solar panels and delivers the electrical power to a combiner box. *See* EX1007, p. 5, middle image (1st-annotation), above.

[209] As discussed above, A POSITA would further understand that the combiner box is one example of a convenient means for merging current from several lead assemblies to a single cable that is applied to the terminal of the inverter. Alternately, a POSITA would understand that the cable assemblies may be arranged so that all of the current from the solar panels in the installation are brought together through a series of junctions and or branch structures, eventually merging to a single cable that can be applied to the terminal of the inverter without need for a combiner box.

[210] For these reasons, a POSITA would have found the limitations in claim element 1(Preamble) to be obvious in view of Amphenol.

a. a drop line terminating at a drop line connector, the drop line connector configured to connect with a central trunk of a wire harness, the central trunk of the wire harness having a plurality of branches that each are configured to electrically connect to a separate solar panel contained in an array of a plurality solar panels;

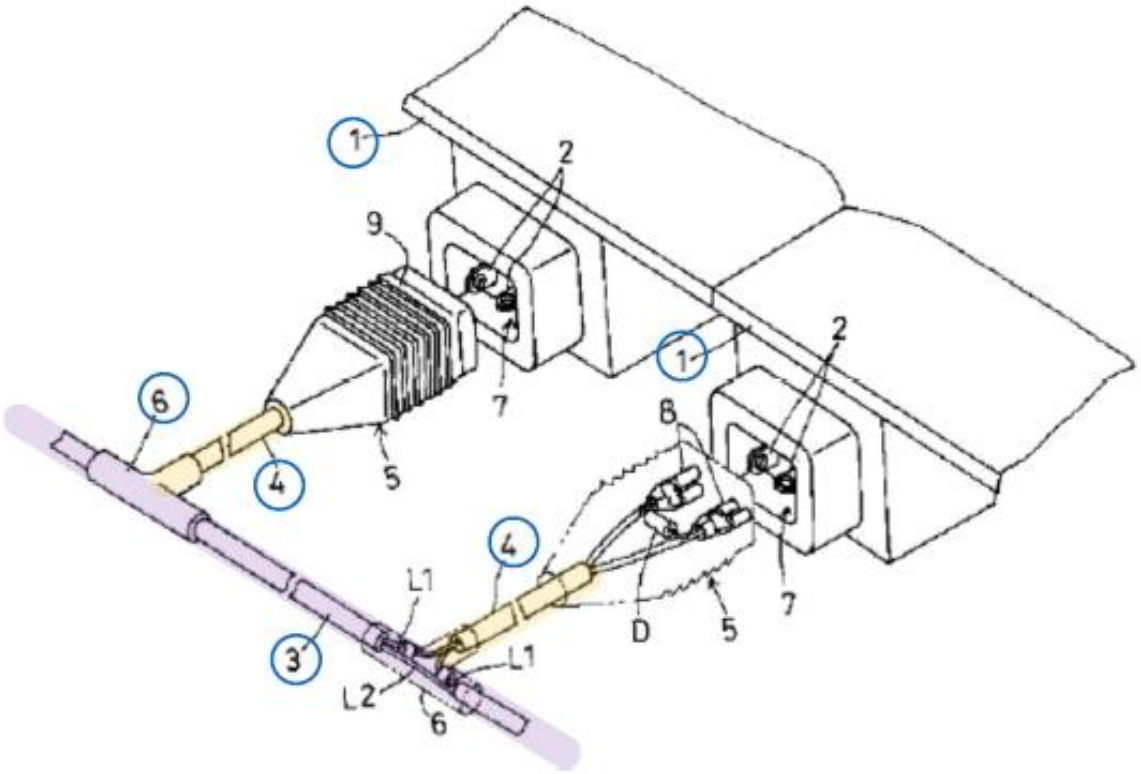
[211] Amphenol discloses, and shows in an illustration reproduced below, two drop lines (annotated in blue) off a feeder cable (annotated in green) of the lead assembly, where each drop line terminates in a drop line connector. *See* EX1007, p. 5, middle image (Relief & 2nd annotation), reproduced below.



EX1007, p. 5, middle image (Relief & 2nd-annotation)

[212] Additionally, as shown in the image above, Amphenol discloses that each drop line connector is connected to a central trunk of a wire harness (annotated as a red dotted line), and the central trunk of the wire harness inherently has a

plurality of branches that each electrically connect to separate solar panels that together are a part of an array of a plurality of solar panels. *See id*., above. A POSITA would understand that the central trunk (e.g., the red dotted line, above) may represent either a serial or parallel connection of a series of solar panel modules. For example, Japanese Patent Application KOKAI Publication No. 7-131045 to Ito ("Ito"), which is cited in the background of Yamawaki (*see* EX1006, 1:28-33), illustrates just such a wire harness with a central trunk for electrically connecting solar panel units. *See* EX1019, FIG. 1 (1st-annotation), reproduced below. In particular, Ito illustrates how the central trunk (trunk line 3) of the wire harness includes branches (branch lines 4) that each electrically connect to a plurality solar panels (solar cell units 1). *See* EX1019, ¶9. Thus, Ito illustrates how the red dotted line in Amphenol would be connected to the solar panels. *See id.*



EX1019, FIG. 1 (1st-annotation)

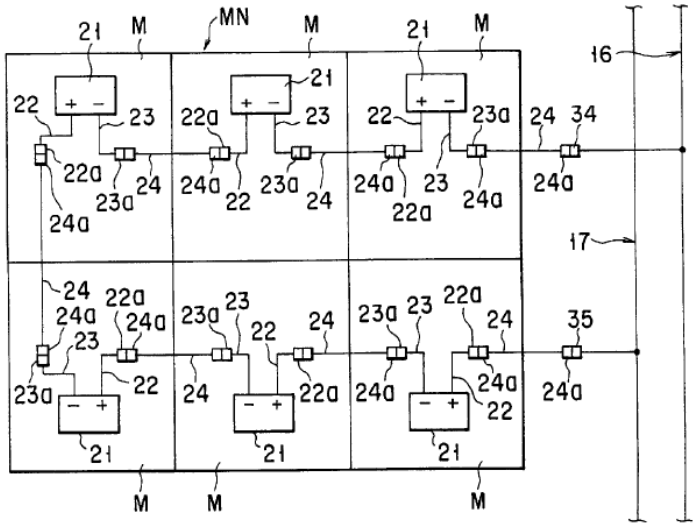
[213] Although Amphenol does not explicitly refer to the cables and wiring assemblies labeled in the annotation above as "drop lines," "a feeder cable," "lead assembly," "a wire harness," or "a central trunk," as discussed above a POSITA would understand that the disclosed cables and wiring assemblies are equivalent and/or analogous to drop lines, a feeder cable, a lead assembly, a wire harness, and/or a central trunk. *See* 'C(i) Motivation to Combine Amphenol and Shao,' discussed above.

[214] A POSITA would appreciate that it would be expensive and complicated to route individual wires from each solar panel all the way to the final terminal of the inverter, and that wire harnesses provide a practical and obvious way to

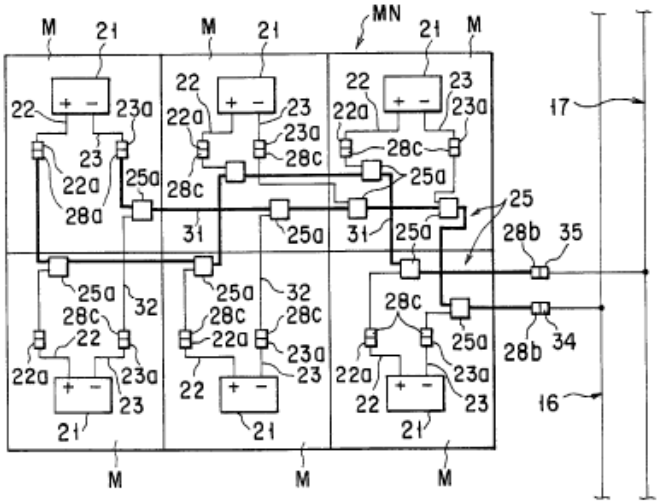
combine the current from a collection of panels, and that cable assemblies provide a practical and obvious way to combine the current from a collection of wire harnesses for delivery to a final terminal of the inverter or combiner box. In addition to the example provided by Amphenol, other prior art, such as Yamawaki, provides several examples of wire harnesses and cable assemblies that can be used as needed for a particular installation for combining the current from solar panels to deliver to a final terminal of the inverter or junction box. For example, Yamawaki shows a wire harness associated with six modules M:

> The six modules M that constitute each module unit MN are connected in series and/or parallel with one another, depending on the required output. Six modules M shown in FIG. 4 are connected in series with one another by means of connecting wires 24. Six modules M shown in FIG. 5 or 6 are connected in parallel with one another by means of wiring apparatuses 25 or 26. Six modules M shown in FIG. 7 are connected in Series and parallel with one another by means of wiring apparatuses 27.

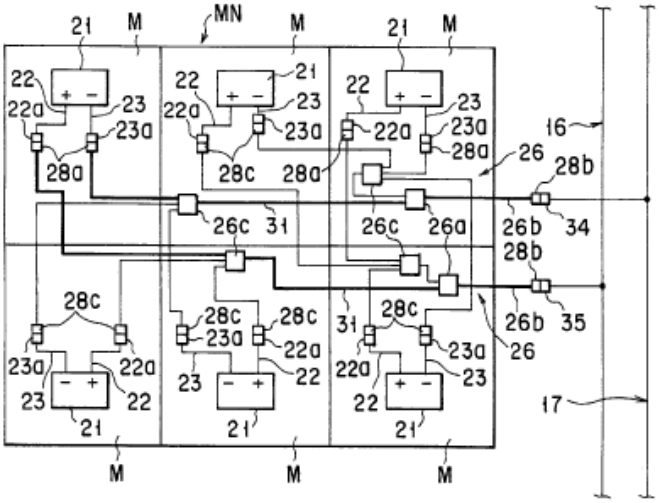
EX1006. Col. 8, lines 17-26 and *see* FIG. 4-6, reproduced below.



EX1006, FIG. 4



EX1006, FIG. 5



EX1006, FIG. 6

[215] The disclosure of Yamawaki describes the use of wiring apparatus (i.e., harnesses) and junctions for a building. *See id*., generally. A POSITA would understand that the disclosure of Yamawaki could be applied to large-scale solar installations by following Yamawaki (e.g., the description for FIG. 3),

which discloses an example arrangement for 8 sets of solar modules (M). *See* EX1006, 8:15-20 and FIG. 3. The wiring assemblies disclosed by Yamawaki can be extended and combined with Amphenol to efficiently form a customized solar installation. Also, a POSITA would understand that these arrangements can be extended using the teachings of Yamawaki to larger-scale solar installations. To meet the specific current and voltage requirements that come with larger-scale installations, a POSITA would make straightforward design decisions, such as selecting components that are individually rated for higher current and higher voltage. The design and manufacture of such components could rely on the teachings of Amphenol, Shao, and Yamawaki and achieve operation at higher voltage and current simply by selection of materials and dimensions of the cables and cable junctions.

[216] As illustrated in the annotated drawings from Amphenol, above (e.g., EX1007, p. 5, middle image (2nd-annotation)), the products described in Amphenol include a number of junctions with feeder cables and drop lines that connect to solar panel arrays. The illustrations and other information shown here describe junctions that provide an electrical connection between the drop line and feeder cable, along with encapsulation needed to protect the metal cables at the junction from the external environment. The above illustration from Amphenol seems to show one example of a combination of Amphenol

components (i.e., a use case for different components). A POSITA would understand that there are many, many other ways to combine the individual Amphenol elements to construct a lead assembly and/or a solar energy installation to match the geometry and design of any particular application. Further, a POSITA would be able to interpret the individual technical information of each element in order to select elements and specify a particular design as needed to accommodate the current and voltage characteristics of the installation.

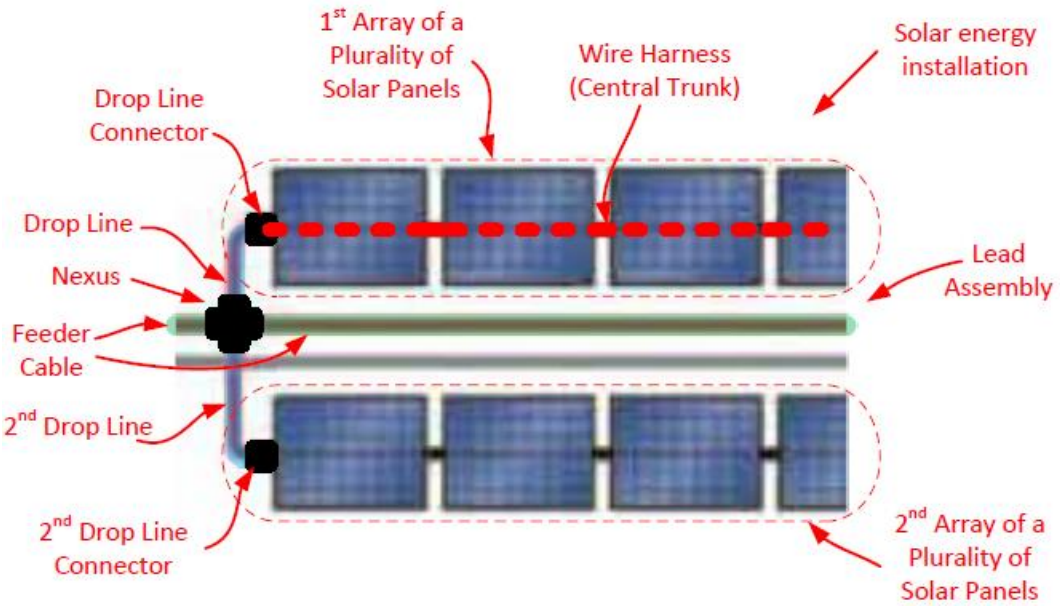
[217] This combination of elements allows solar panels to connect through drop lines that terminate at a drop line connector. The drop line connectors make electrical and physical connections with a central trunk of a wire harness. As noted above with respect to the disclosures in Amphenol, a POSITA would appreciate that the many examples of wire harnesses, cable assemblies, and cable branches disclosed in Amphenol are intended as a catalog of options for design of a solar array installation, with the possibility of combining the many elements in Amphenol in various ways to accommodate the specific features and circumstances of a particular installation, including options for connecting the array elements in series or parallel as needed. In order to meet the needs of any particular installation, a POSITA would understand that the central trunk of the wire harness must inherently have a plurality of branches that are

configured to electrically connect to separate solar panels contained in an array.

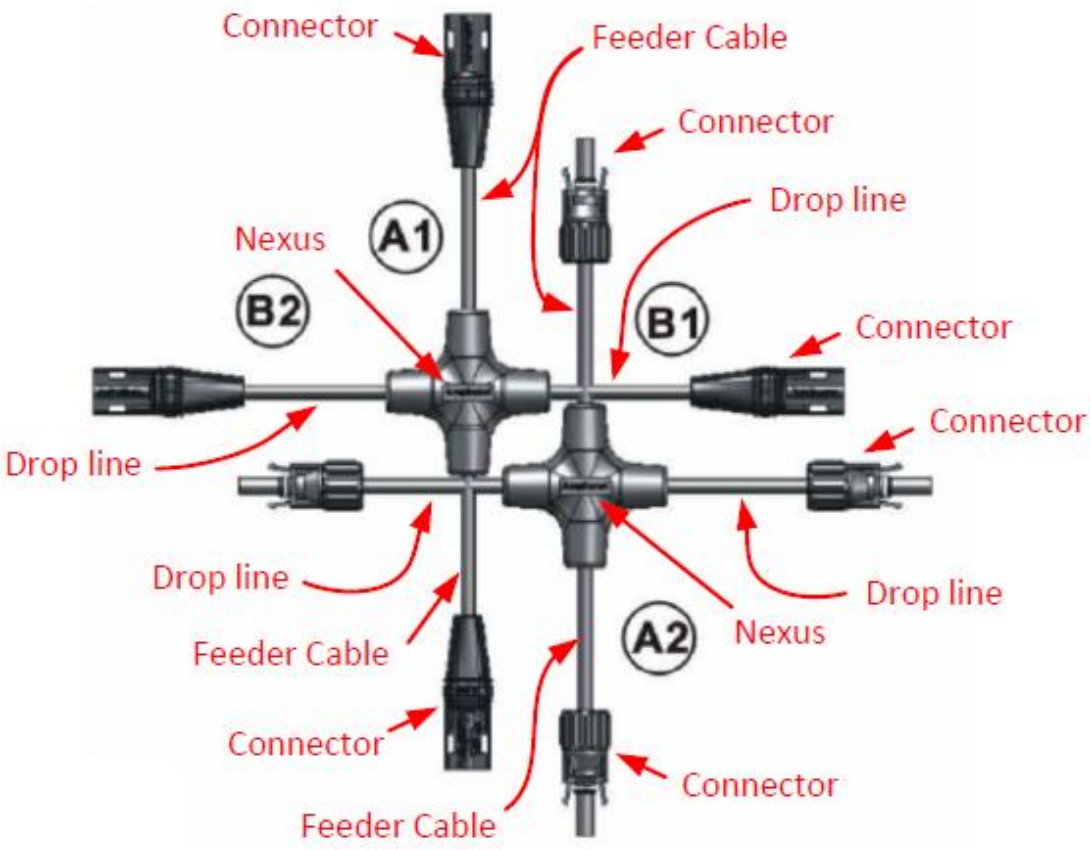
[218] For these reasons, a POSITA would have found the limitations in claim 1(a) to be obvious based on Amphenol and Yamawaki.

b. a feeder cable electrically coupled to the drop line at a nexus;

[219] Amphenol discloses, and shows in images reproduced below, a feeder cable (i.e., a "main cable") electrically coupled to the drop line (i.e., a "branch cable") at a nexus. *See* EX1007, p. 5, middle image (Relief & 2nd-annotation) and p. 13, bottom image (1st-annotation), reproduced below.



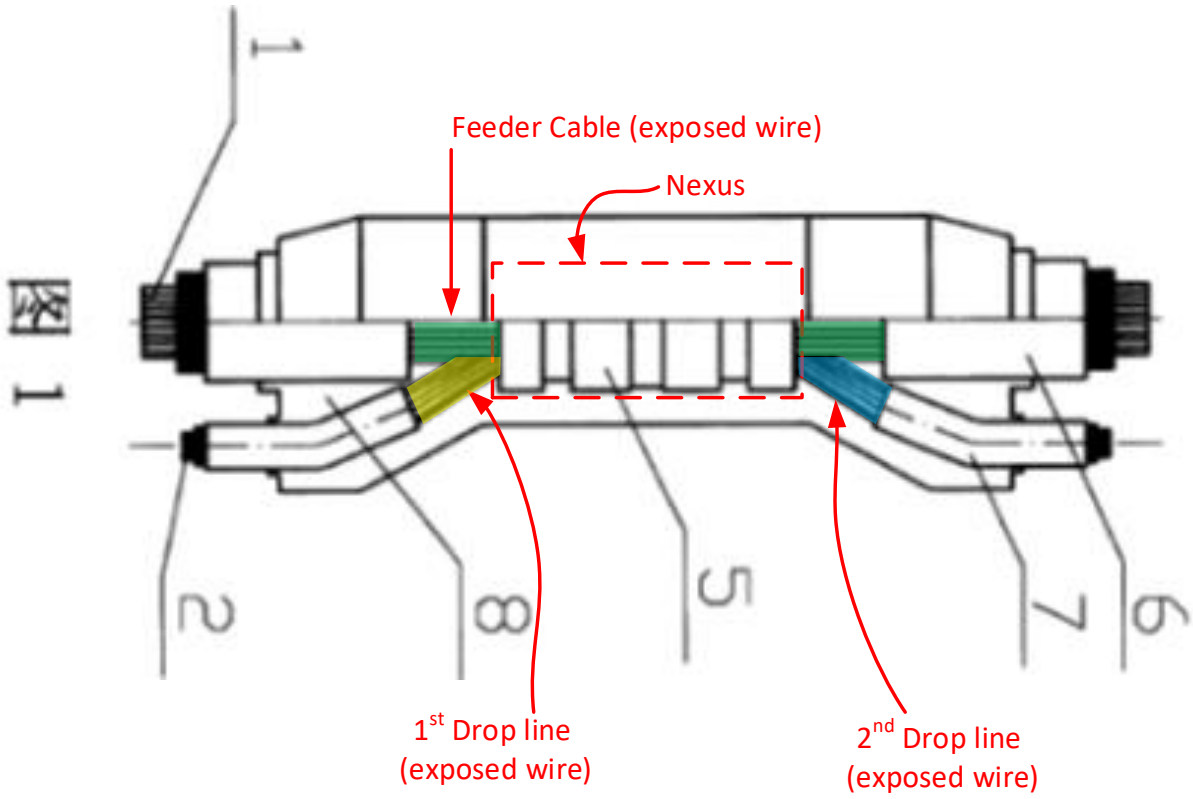
EX1007, p. 5, middle image (Relief & 2nd-annotation)



EX1007, p. 13, bottom image (1st-annotation)

[220] Amphenol, on p. 21, discloses and illustrates in images various junction cable assembly configurations, referring to the feeder cable as a "main cable" (labeled "A1" and "A2" in the bottom image on p. 21, shown above) and each of the drop lines as a "branch cable" (labeled "B1" and "B2" in the bottom image on p. 21, shown above). *See* EX1007, p. 13. While Amphenol inherently discloses the electrical coupling of the feeder cable and the drop line at a nexus, Amphenol does not illustrate the actual electrical coupling between the feeder cable and drop line that is inside the illustrated molded junction. Shao discloses details of the feeder cable's electrical coupling to the drop line at

the nexus, along with details associated with the encapsulation of the junction to provide protection from the external environment. Shao, which is in the related field of electrical connectors, discloses a feeder cable electrically coupled to the drop line at a nexus that includes a clamp holding the feeder cable in contact with the drop line. *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

[221] Shao discloses a feeder cable (trunk conductor 1) electrically coupled to a drop line (branch-line conductor 2) at a nexus that includes a clamp (connector 5). *See* EX1008, FIG.1 (1st-annotation). As illustrated, Shao discloses a nexus configuration with a clamp to ensure contact and good conductivity is

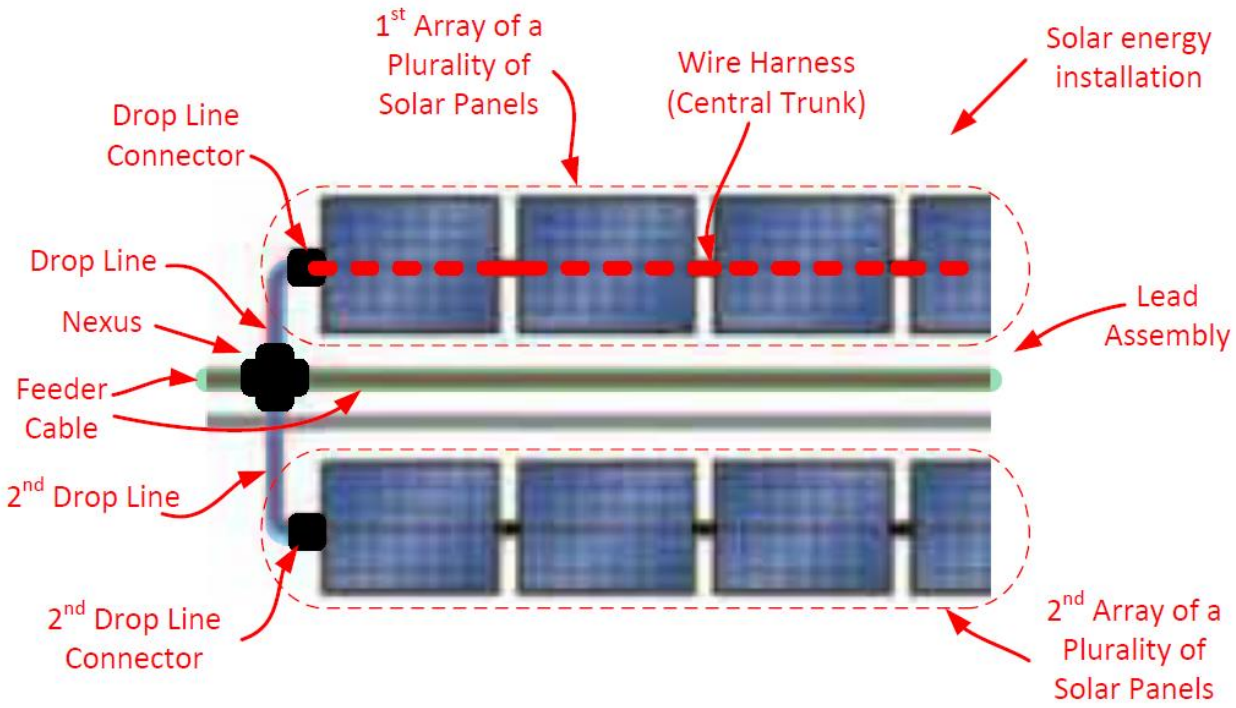
maintained between the two conductive elements (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed above). A POSITA would be motivated to use the coupling design of Shao for ensuring a proper electrical connection for the cable junctions of Amphenol.

[222] For these reasons, a POSITA would have found the limitations in claim 1(b) to be obvious in view of the Amphenol-Shao-Yamawaki combination.

c. an undermold that fully encases the nexus, the undermold further comprising:

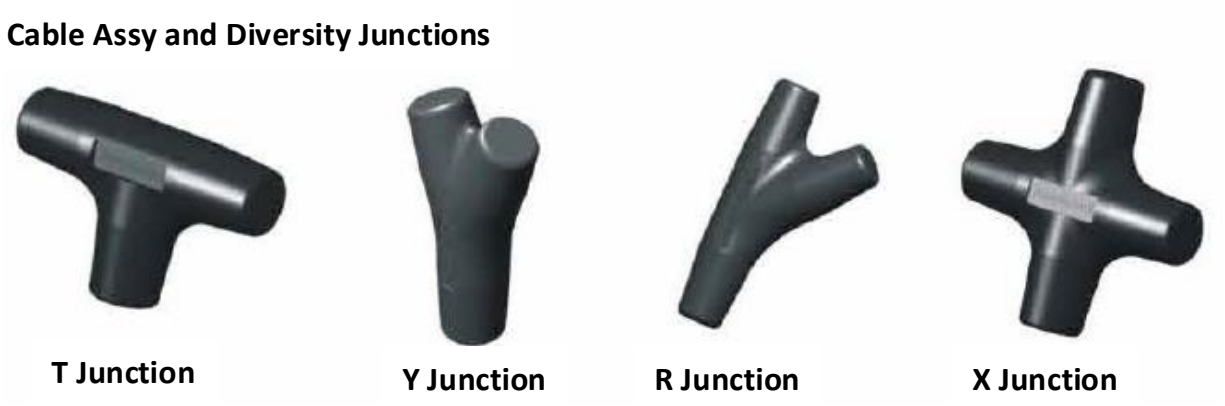
[223] As noted above in Ground 1, claim 1(c), the specification of the '153 Patent does not define the term "undermold." For the reasons discussed above in Ground 1 regarding claim 1(c), which I incorporate by reference here, it is my opinion that a POSITA would have understood that "undermold" means a "material molded over a piece or part that seals against environmental factors and is surrounded by an 'overmold.'" *See* EX1001, FIGS. 48, 54, 55, 60 and generally.

[224] The molded junction covering the wiring and union of the various forms of nexus in Amphenol is an undermold that fully encases the nexus since the molded junction covering the nexus may serve as a substrate for an overmold. *See* EX1007, p. 5, middle image (Relief & 2nd-annotation), reproduced below.



EX1007, p. 5, middle image (Relief & 2nd-annotation)

[225] In fact, Amphenol discloses various different types of molded junctions (i.e., undermolds) that may be used to enclose a nexus. *See* EX1007, p.5, bottom image, reproduced below. The junction annotated as the "Nexus," above from Amphenol is referred to as an "X Junction" in the 'Cable Assy and Diversity Junctions' figure reproduced below, which is also from Amphenol. *See id*.

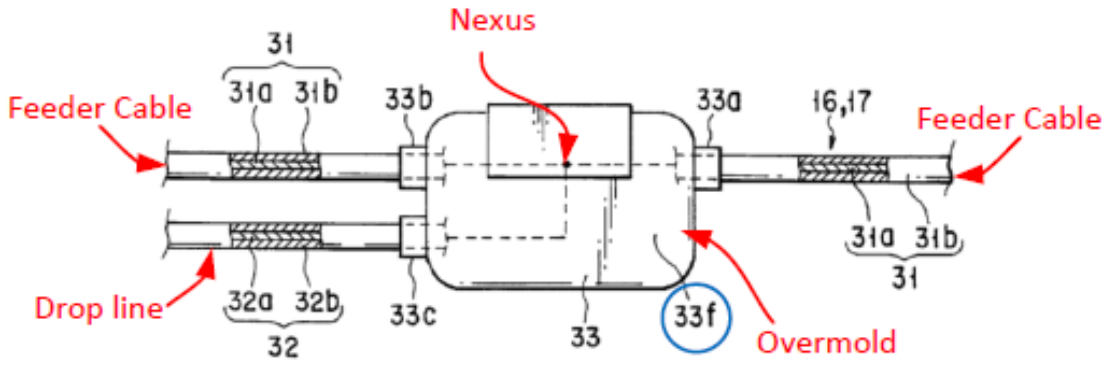


EX1007, p. 5, bottom image

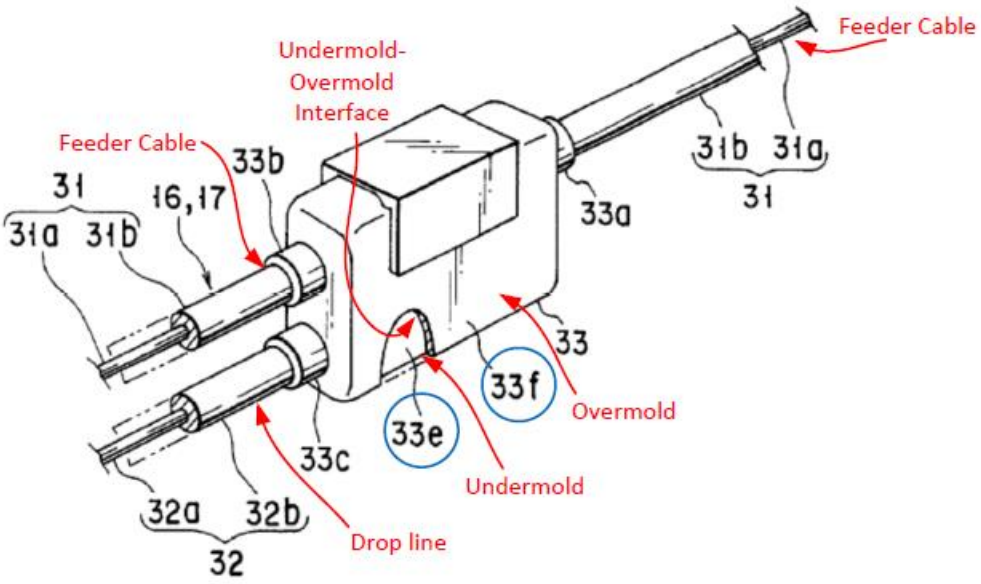
[226] Shao discloses a feeder cable electrically coupling to drop lines at a nexus that is covered by a sheath made of injection molding material, which is an undermold that fully encases the nexus. *See* EX1008, 5: 16-20. The examples of junctions shown on page 5 of Amphenol (T Junction, Y Junction, R Junction, X Junction) are examples of 2-terminal, 3-terminal, and 4-terminal junctions that one would consider for use in lead assemblies. A POSITA would understand that these example junctions, and many more similar examples could be assembled as disclosed in Shao. For example, it would have been obvious to a POSITA to rely on the teaching of Shao to provide the design of the cable junction, including methods for baring wires, providing a clamp, forming a nexus by closing the clamp around the wires, and providing an injection-molded undermold to encase the exposed cables and the metal clamp holding them together and protect those elements from damage and/or exposure (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed

above).

[227] Yamawaki also teaches this limitation. Yamawaki teaches applying an overmold over an undermold of a branch cable connection to provide an added layer of waterproofing. *See* EX1006, 10:19-22; 13:15-18. In particular, Yamawaki discloses applying an overmold (i.e., covering member 33f) over the undermold (i.e., molded underbody 33e) covering a nexus (i.e., a branch junction) of cables (i.e., a feeder cable and a branch cable). *See id.*, FIGS. 9A (1st-annotation) and 9B (1st-annotation), reproduced below.



EX1006, FIG. 9A (1st-annotation)



EX1006, FIG. 9B (1st-annotation)

[228] A POSITA considering Shao and Yamawaki would appreciate that these two disclosures describe methods for encasing cable junctions with insulating layers that can provide protection from the environment and other benefits discussed earlier with respect to Yamawaki (*see* 'C(ii) Motivation to Combine Amphenol, Shao, and Yamawaki' further discussed above). A POSITA considering Shao and Yamawaki would have found it obvious to incorporate an undermold to the Amphenol-Shao combination in order to provide protection against environmental elements (e.g., waterproofing), as taught by Yamawaki (*see* 'C(ii) Motivation to Combine Amphenol, Shao, and Yamawaki" further discussed above).

[229] For these reasons, a POSITA would have found the limitations in claim 1(c)

to be obvious in view of the Amphenol-Shao-Yamawaki combination.

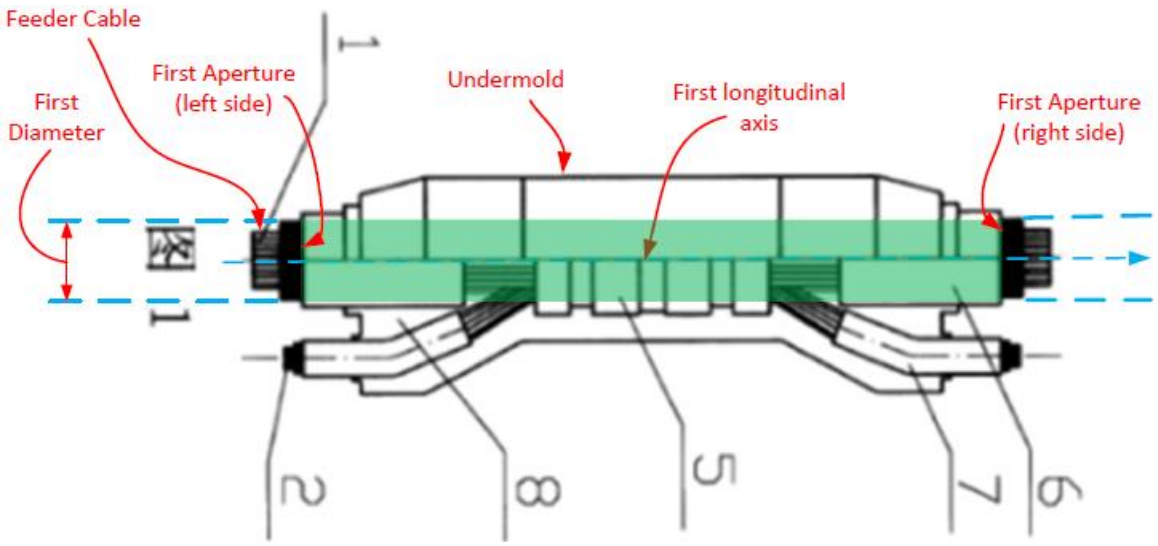
i. a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis; and

[230] A POSITA viewing the T, Y, R, and X junctions examples shown in the figures from Amphenol, below, would understand that the wires passing through the junction will necessarily use a path through the mold material, thus forming one or more apertures extending through and/or into the mold. *See* EX1007, p.5, bottom image, reproduced below.



EX1007, p. 5, bottom image

[231] Shao discloses a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis. *See* EX1008, FIG. 1 (2nd-annotation), reproduced below.

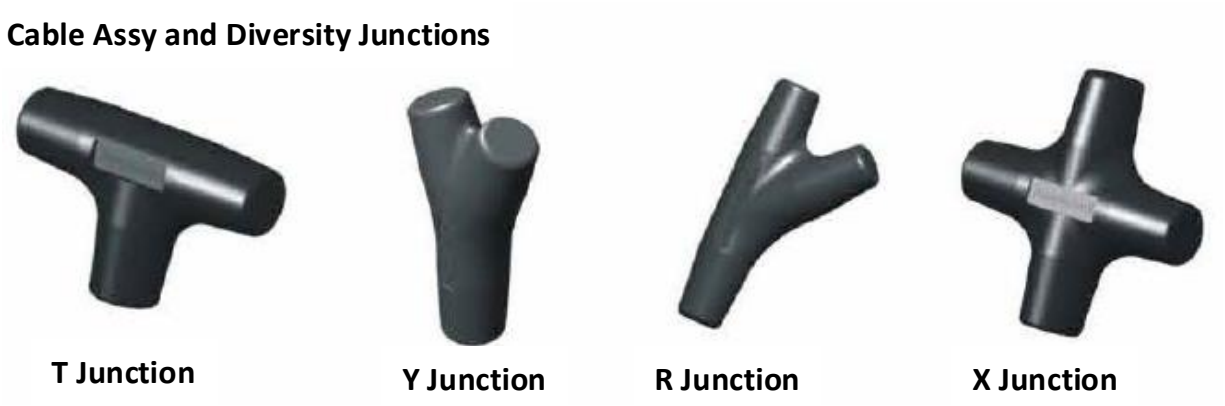


EX1008, FIG. 1 (2nd-annotation)

[232] For these reasons, a POSITA would have found the limitations in claim 1(c)(i) to be obvious in view of the Amphenol-Shao-Yamawaki combination.

ii. a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis;

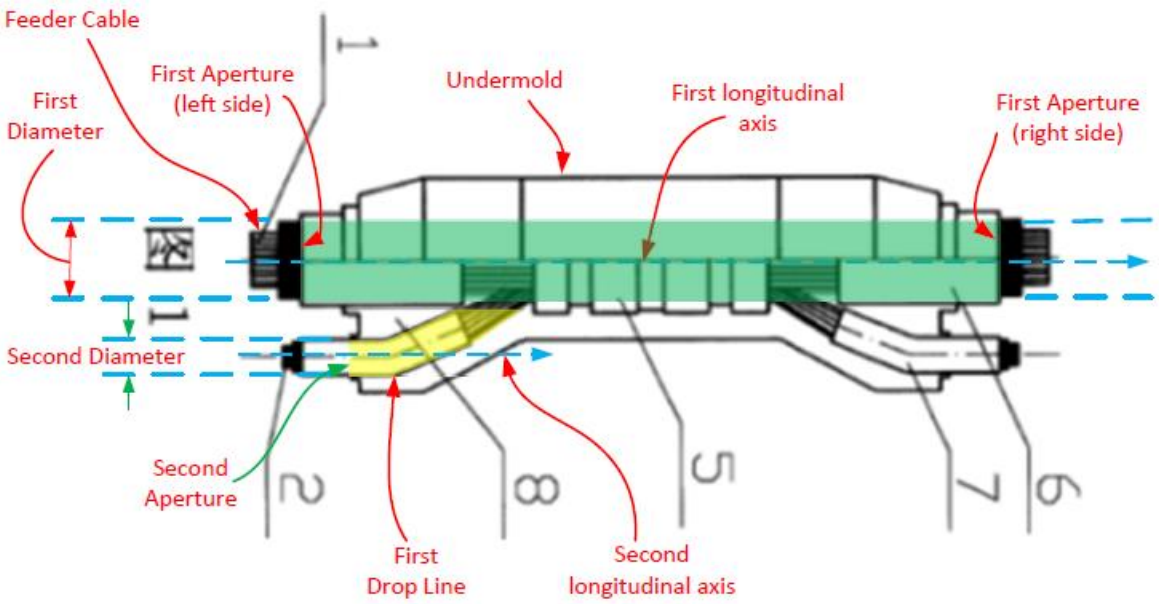
[233] A POSITA viewing the T, Y, R, and X junctions examples shown in the figures from Amphenol, below, would understand that the branch wire or wires being coupled to the main wire in these junctions necessarily fill paths into the mold material, thus forming a "second aperture" extending partially through the mold. *See* EX1007, p.5, bottom image, reproduced below.



EX1007, p. 5, bottom image

[234] If the current carried by the attached wires is less than the main line, which will be the case for drop lines connecting to a main line, a POSITA would know to use smaller diameter cables based on NEC2002 guidelines, and thus the "second aperture" would have a smaller diameter than the first aperture around the main line. Further, the T, Y, R, and X junctions examples show the connecting wires, and thus the second aperture, exiting the junction along a different longitudinal axis.

[235] Shao discloses a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis. *See* EX1008, (3rd-annotation), reproduced below.



EX1008, FIG. 1 (3rd-annotation)

[236] As described by Shao, "One trunk conductor and two branch-line conductors are symmetrically overlapped and crimped by means of the K-shaped branch connector 5 to form one joint and two branch-line conductor out-leads, and directions of the branch-line conductor out-leads are opposite." *Id*., 6:18-22. A first branch line conductor is associated with a first drop line. As this conductor is prepared as a single conductor that has insulation stripped from an end and crimped, this element and the associated aperture meets the limitations of this element.

[237] For these reasons, a POSITA would have found the limitations in claim 1(c)(ii) to be obvious in view of the Amphenol-Shao-Yamawaki combination.

iii. a third aperture extending partially through the undermold and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis; and

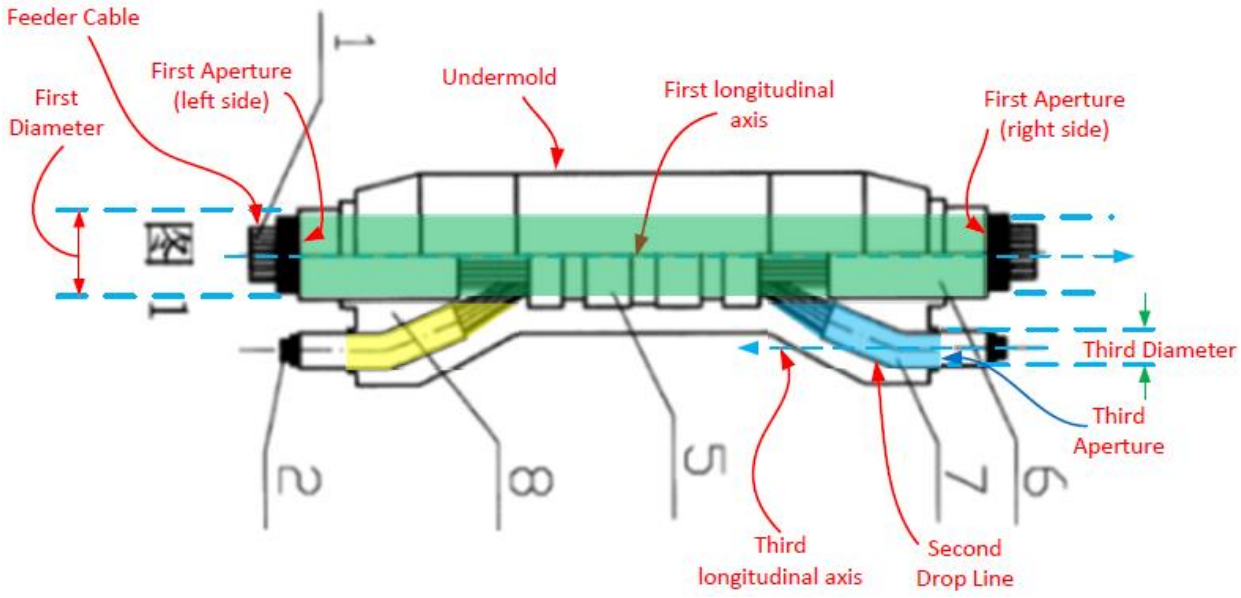
[238] A POSITA viewing the X junction example shown in the figure from Amphenol, below, would understand that the branch wire or wires being coupled to the main wire in these junctions necessarily fill paths into the mold material, thus forming a "third aperture" extending partially through the mold. If the current carried by the attached wire is less than the main line, which will be the case for drop lines connecting to a main line, a POSITA would know to use smaller diameter cables based on NEC2002 guidelines, and thus the "third aperture" would have a smaller diameter than the first aperture around the main line. Further, the X junction example shows the connecting wire, and thus the third aperture, exiting the junction along a longitudinal axis different from the axis of the main wire. *See* EX1007, p.5, X Junction from bottom image, reproduced below.



X Junction

EX1007, p. 5, X Junction from bottom image

[239] Shao discloses a third aperture extending partially through the undermold and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis. *See* EX1008, (4th-annotation), reproduced below.



EX1008, FIG. 1 (4th-annotation)

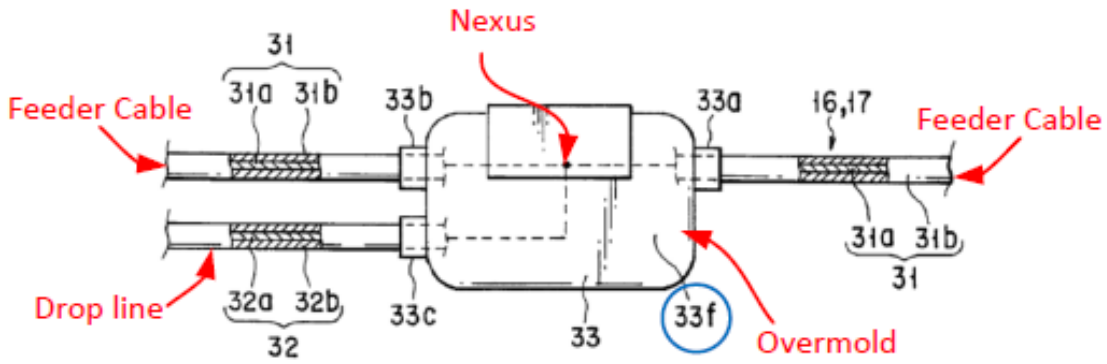
[240] Shao specifically discloses the connection of "One trunk conductor and two

branch-line conductors are symmetrically overlapped and crimped by means of the K-shaped branch connector 5 to form one joint and two branch-line conductor out-leads." *See id*., 6:18-21. Shao discloses a feeder cable (i.e., single trunk conductor 1) and a pair of drop lines (i.e., branch line conductors 2) that are brought together by the crimp (connector 5) to form the junction. *See* EX1008, (4th-annotation), above. This arrangement provides for a first aperture (along the trunk conductor), and a second and third aperture (along the two branch-line conductors).

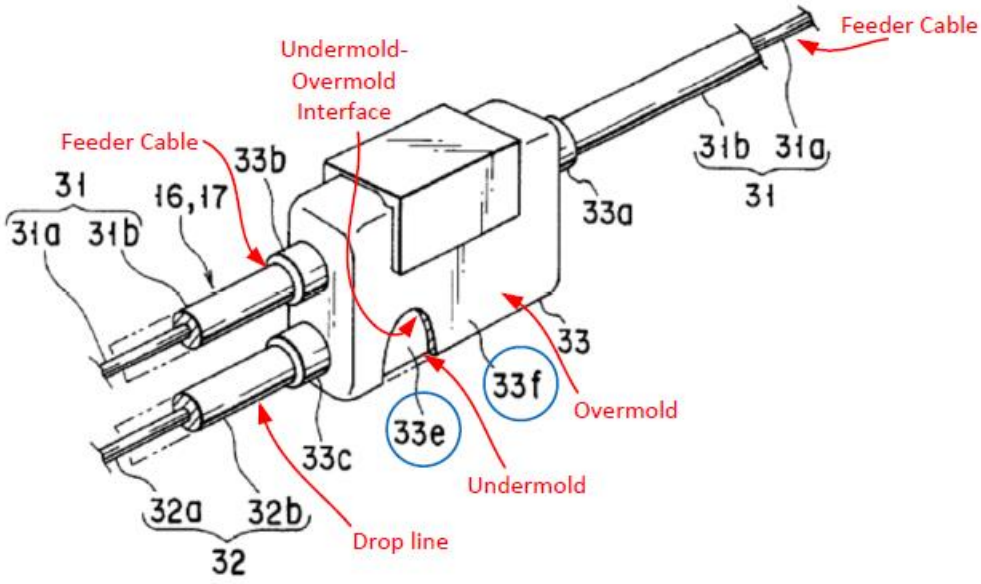
[241] For these reasons, a POSITA would have found the limitations in claim 1(c)(iii) to be obvious in view of the Amphenol-Shao-Yamawaki combination.

d. an overmold surrounding the undermold and forming an undermold-overmold interface at an outer surface of the undermold.

[242] Yamawaki teaches applying an overmold over an undermold of a branch cable connection to provide an added layer of waterproofing. *See* EX1006, 10:19-22; 13:15-18. In particular, Yamawaki discloses applying a covering member (i.e., an overmold) over the molded underbody (i.e., an undermold) covering a branch junction (i.e., a nexus) of cables (i.e., a feeder cable and a branch cable). *See id*. As shown in FIGS. 9A (1st-annotation) and 9B (1st-annotation), reproduced below. *See* FIGS. 9A (1st-annotation) and 9B (1st-annotation), reproduced below.



EX1006, FIG. 9A (1st-annotation)



EX1006, FIG. 9B (1st-annotation)

[243] A POSITA considering Shao and Yamawaki would appreciate that these two disclosures describe methods for encasing cable junctions with insulating layers that can provide protection from the environment and other benefits discussed earlier with respect to Yamawaki (*see* 'C(ii) Motivation to Combine Amphenol, Shao, and Yamawaki' further discussed above). A POSITA considering Shao

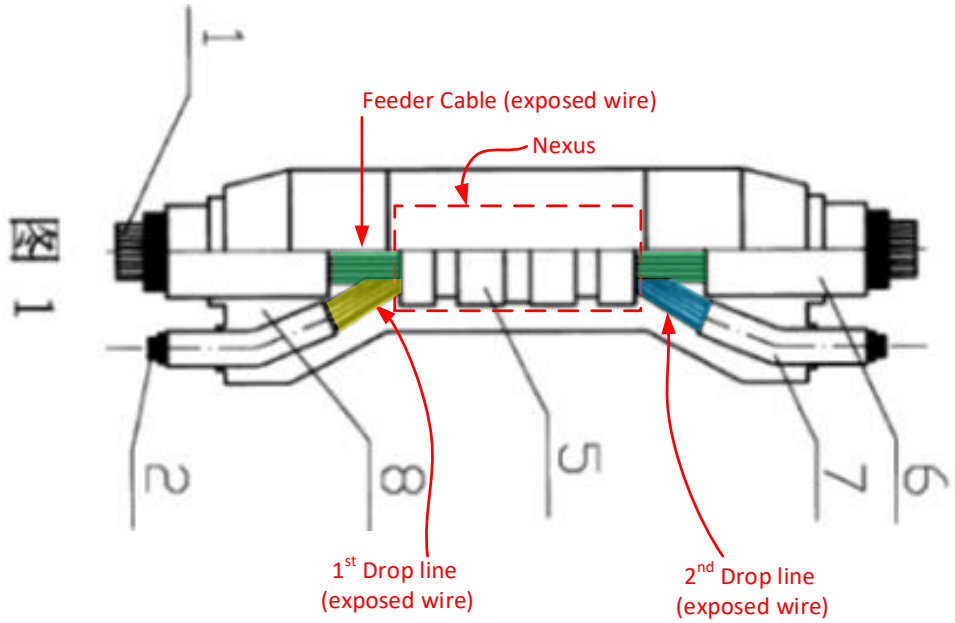
and Yamawaki would have found it obvious to add an overmold to the Amphenol-Shao combination in order to provide the added protection against environmental elements (e.g., waterproofing), as taught by Yamawaki (*see* 'C(ii) Motivation to Combine Amphenol, Shao, and Yamawaki' further discussed above). For these reasons, a POSITA would have found the claim 1(d) limitations to be obvious in view of the Amphenol-Shao-Yamawaki combination.

[244] A POSITA would have found claim 1 to be obvious based on the Amphenol-Shao-Yamawaki combination. Accordingly, claim 1 should be found invalid under 35 U.S.C. § 103 based on Amphenol, Shao, and Yamawaki.

2. Claim 2

The lead assembly of claim 1 wherein the drop line includes a section of exposed wire at the *nexus*.

[245] Shao discloses, and shows in an illustration reproduced below, that the drop line (i.e., branch-line conductor 2) includes a section of exposed wire (colored yellow in the annotation below) at the nexus. *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

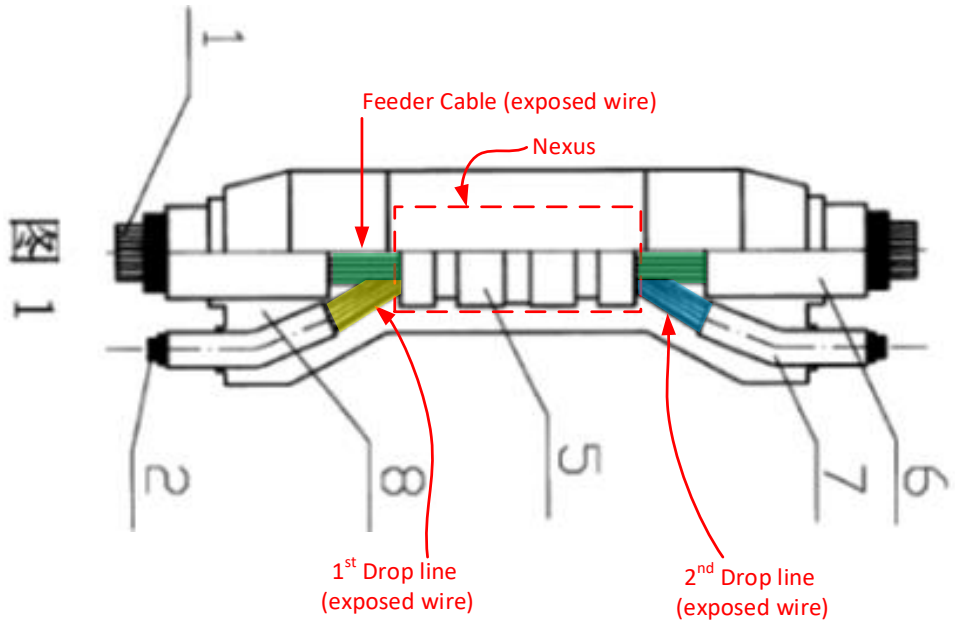
[246] As a general observation, any cable junction that combines multiple cables must include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables. Therefore, it would be obvious to include a section of exposed wire for the feeder cable and the drop line at the location of the nexus. Nevertheless, Shao discloses the details of the cable junction including the obvious need to remove insulation and provide exposed wire for the feeder cable and the drop lines at the nexus.

[247] For these reasons, a POSITA would have found the limitations in claim 2 to be obvious based on the Amphenol-Shao-Yamawaki combination.

3. Claim 3

The lead assembly of claim 2 wherein the feeder cable includes a section of exposed wire at the *nexus*.

[248] Shao discloses, and shows in an illustration reproduced below, that the feeder cable (i.e., trunk conductor 1) includes a section of exposed wire (colored green in the annotation below) at the nexus. *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

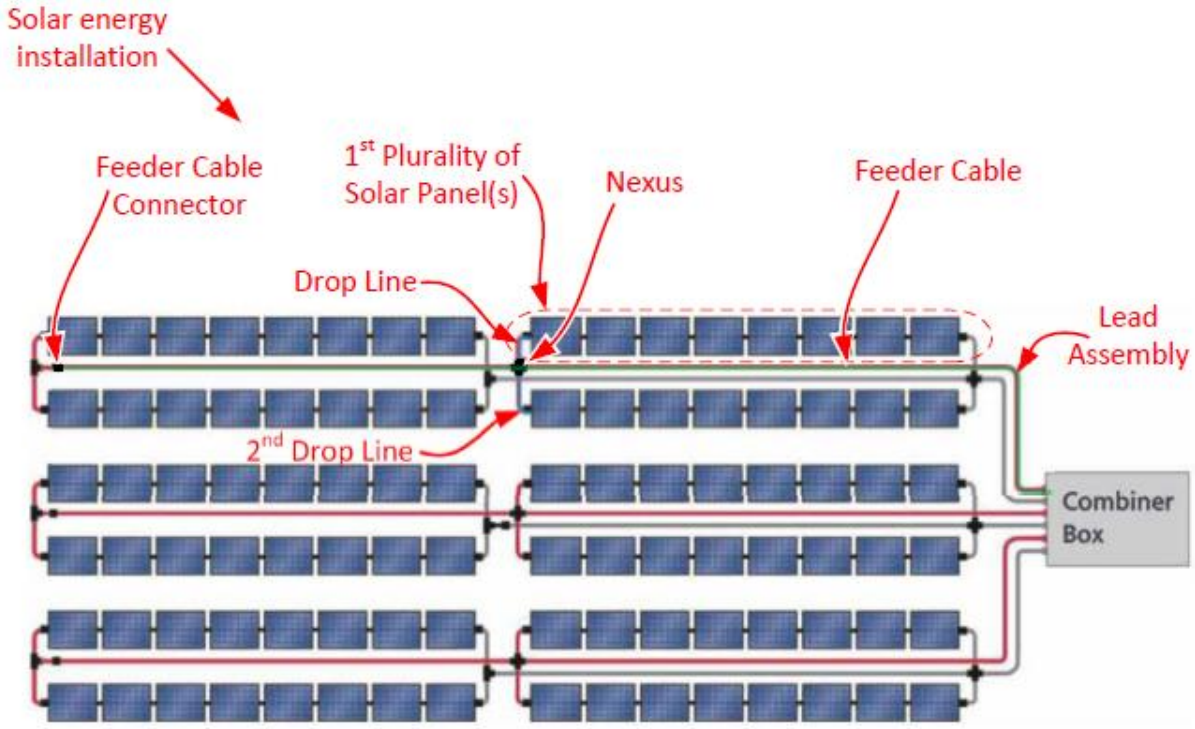
[249] As discussed above, any cable junction that combines multiple cables must include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables.

[250] For these reasons, a POSITA would have found the limitations in claim 3 to be obvious based on the Amphenol-Shao-Yamawaki combination.

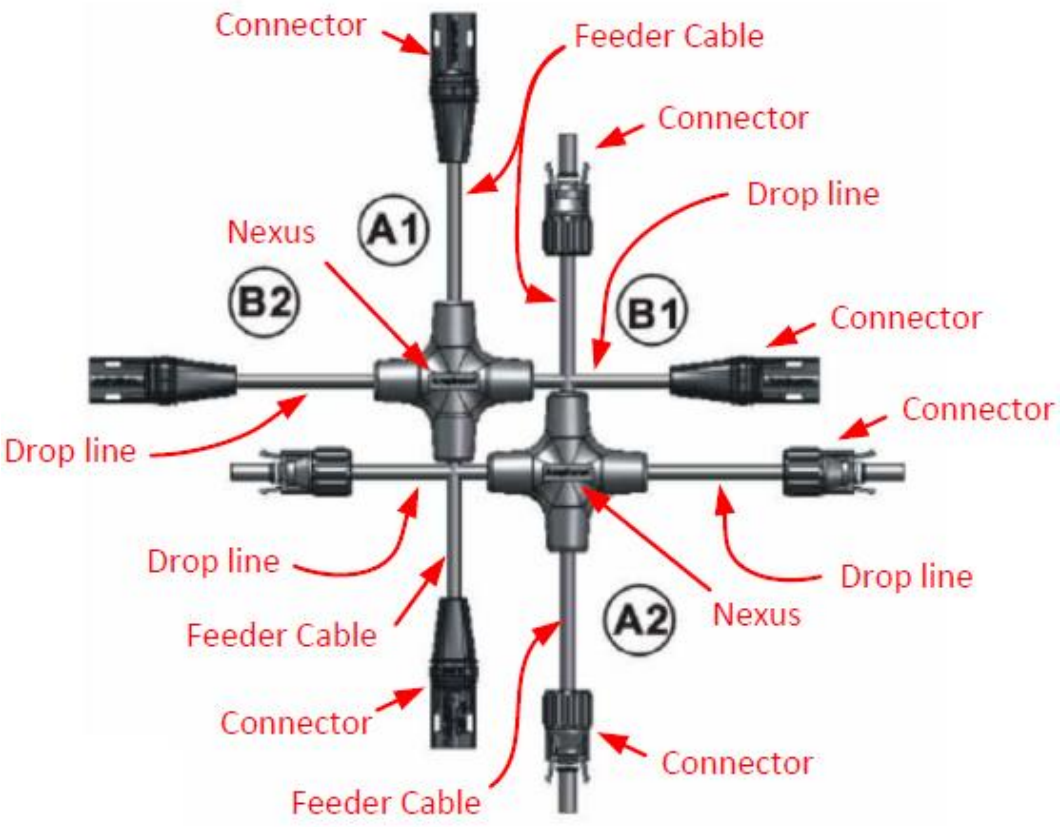
4. Claim 5

The lead assembly of claim 1, wherein the feeder cable terminates at a feeder cable connector.

[251] Amphenol discloses, and shows in illustrations reproduced below, that the feeder cable terminates at a feeder cable connector. *See* EX1007, p. 5, middle image (2nd-annotation) and p. 13, bottom image (1st-annotation), reproduced below.



EX1007, p. 5, middle image (2nd-annotation)



EX1007, p. 13, bottom image (1st-annotation)

[252] For these reasons, a POSITA would have found the limitations in claim 5 to be obvious based on the Amphenol-Shao-Yamawaki combination.

5. Claim 6

The lead assembly of claim 5, wherein the feeder cable connector is configured to attach directly to an inverter.

[253] I am informed by Counsel that the recitation of "the feeder cable connector is configured to attach directly to an inverter," is an intended use limitation since it recites a feature (i.e., the feeder cable connector) by what it does (i.e., attach directly to an inverter) rather than by what it is. Nonetheless, although

Amphenol doesn't disclose the feeder cable connector attached directly to an inverter, this wiring configuration was well known to POSITAs. *See* EX1010, Fig. 690.1(B)(top diagram), p.544, reproduced below. For example, a POSITA would have been familiar with the NEC 2002 which illustrates in Figure 690.1(B) of a main feeder cable of a branching "photovoltaic source circuit" connected directly to an inverter. *See id*.

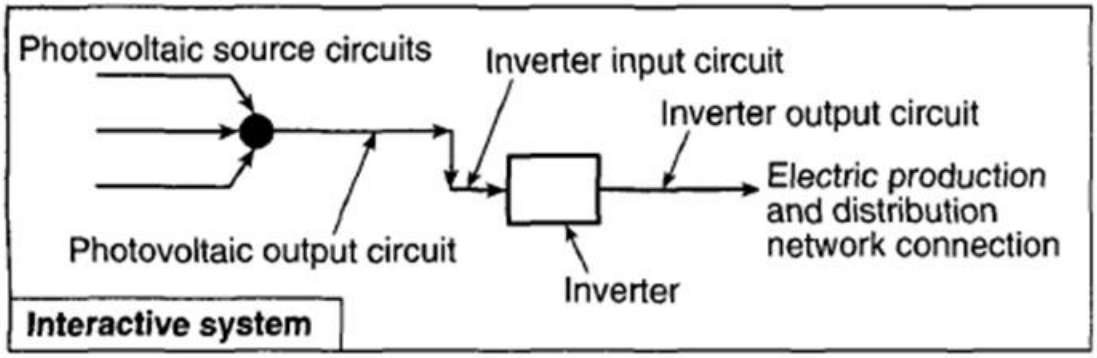


Figure 690.1(B) (top diagram)

[254] Further, a POSITA would have been motivated to attach a feeder cable directly to an inverter, particularly for installations in which the inverter is in close proximity and can extend to be connected directly to feeder cable without the need for a jumper cable.

[255] As discussed above, a POSITA would further understand that the combiner box is one example of a convenient means for merging current from several lead assemblies to a single cable that is applied to the terminal of the inverter. Alternately, a POSITA would understand that the cable assemblies may be arranged so that all of the current from the solar panels in the installation are

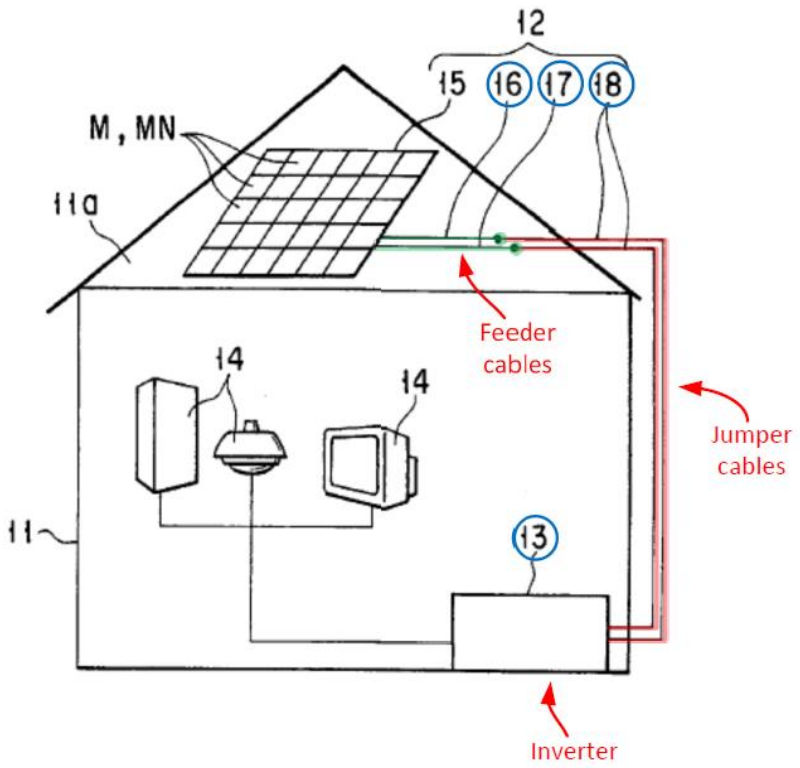
brought together through a series of junctions and or branch structures to a single cable that can be applied to the terminal of the inverter without need for a combiner box.

[256] Therefore, it would have been obvious to a POSITA to attach the feeder cable connector directly to an inverter based on the disclosure of Amphenol and well known design choice. For these reasons, a POSITA would have found the claim 6 limitations to be obvious based on the Amphenol-Shao-Yamawaki combination. For these reasons, a POSITA would have found the limitations in claim 6 to be obvious based on the Amphenol-Shao-Yamawaki combination.

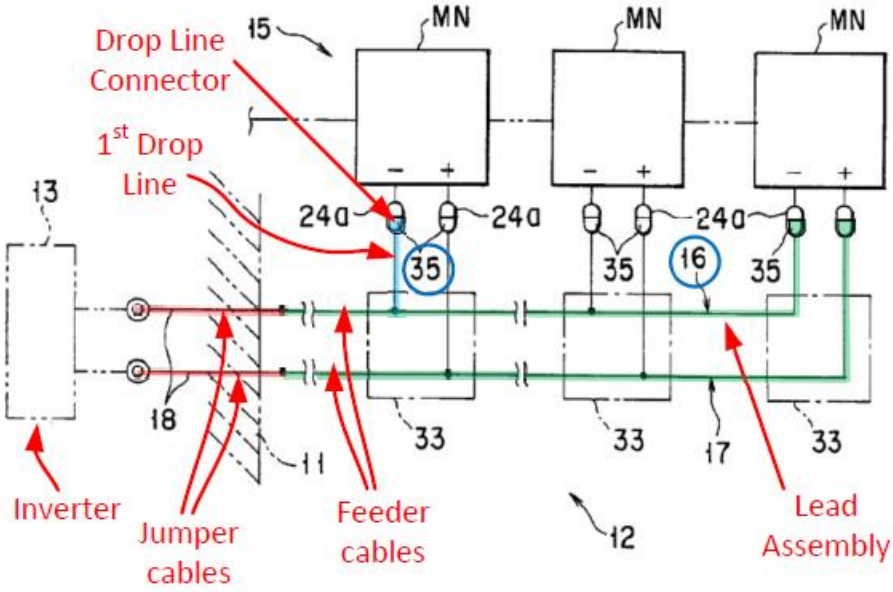
6. Claim 7

The lead assembly of claim 5, wherein the feeder cable connector is configured to attach directly to a jumper cable, which in turn connects directly to an inverter.

[257] The recitation that "the feeder cable connector is configured to attach directly to a jumper cable, which in turn connects directly to an inverter," is an intended use limitation since it recites a feature of a feeder cable connector by what it does (e.g., attach directly to a jumper cable) rather than by what it is. Nonetheless, Yamawaki discloses and illustrates attaching a feeder cable directly to a jumper cable, which in turn connects directly to an inverter. *See* EX1006, 7:45-8:11, FIG. 1 (1st-annotation), and FIG. 2 (1st-annotation), reproduced below.



EX1006, FIG. 1 (1st-annotation)



EX1006, FIG. 2 (1st-annotation)

[258] A POSITA would further understand that the disclosure of Yamawaki could

be applied to large-scale solar installations as discussed in the figures and descriptions for FIG. 3, which disclose example arrangements for 8 sets of solar modules, and a POSITA would understand that this could be extended using the teachings of Yamawaki to larger scale. To meet the specific current and voltage requirements that come with larger-scale installations, a POSITA would make straightforward design decisions, such as selecting components that are individually rated for higher current and higher voltage, such as according to the NEC2000 (EX1010). The design and manufacture of such components could rely on the teachings of Amphenol, Shao and Yamawaki and achieve operation at higher voltage and current simply by selection of materials and dimensions of the cables and cable junctions.

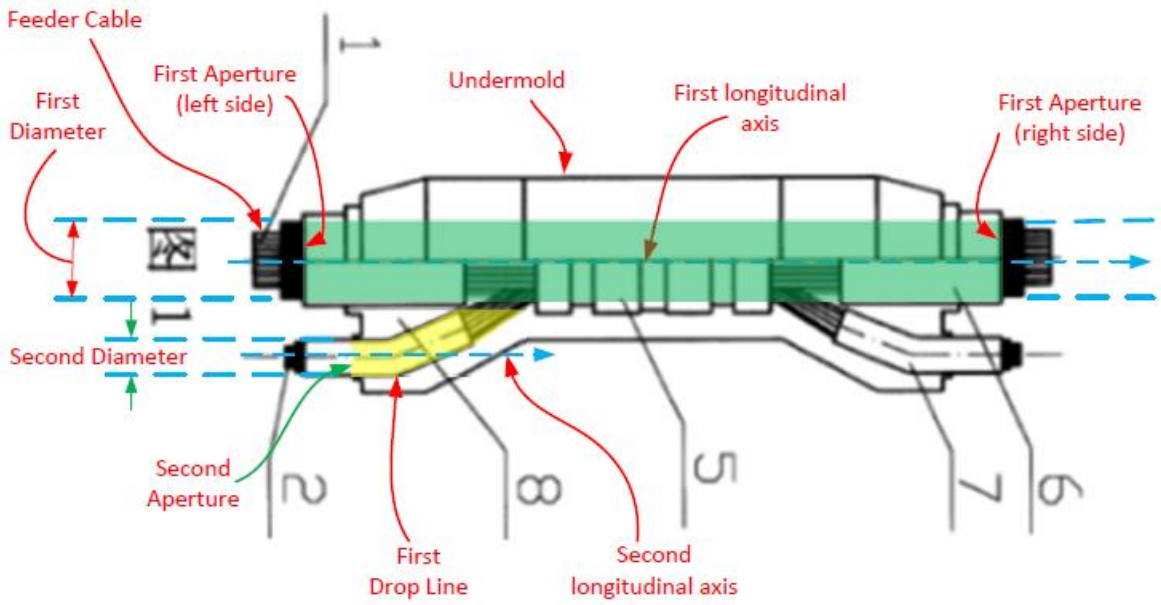
[259] For these reasons, a POSITA would have found the limitations in claim 7 to be obvious based on the Amphenol-Shao-Yamawaki combination.

7. Claim 8

The lead assembly of claim 1, wherein the first longitudinal axis and the second longitudinal axis are substantially parallel.

[260] Shao discloses, and shows in an illustration reproduced below, that the first longitudinal axis (of the first aperture) and the second longitudinal axis (of the second aperture) are substantially parallel. *See* EX1008, (3rd-annotation), reproduced below. This configuration of substantially parallel axis provides a

compact configuration enabling branch wires to divide off from the feeder cable, while maintaining a profile not much wider than the original feeder cable. *See id*.



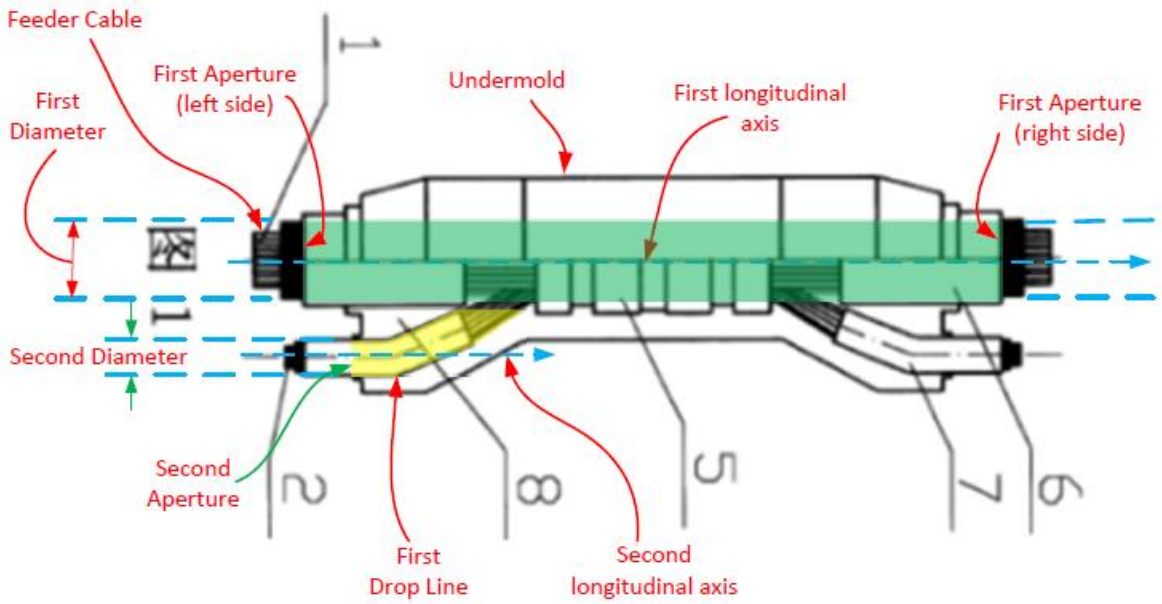
EX1008, FIG. 1 (3rd-annotation)

[261] For these reasons, a POSITA would have found the limitations in claim 8 to be obvious based on the Amphenol-Shao-Yamawaki combination.

8. Claim 9

The lead assembly of claim 1, wherein the second diameter is smaller than the first diameter.

[262] Shao discloses, and shows in an illustration reproduced below, that the second diameter (of the second aperture) is smaller than the first diameter (of the first aperture). *See* EX1008, FIG. 1 (3rd-annotation), reproduced below.



EX1008, FIG. 1 (3rd-annotation)

[263] A POSITA would understand that the drop lines bring current from individual solar array elements and merges this current with the other current already flowing from other elements in the feeder cable. Generally, drop lines carry less current than feeder cables, and as a result can be smaller diameter cables that are lighter, easier to manipulate, and less expensive. A POSITA would use established electrical practices to select the cables for drop lines and feeder cables with diameters (or gauge) based on their design currents as specified in the NEC2000 (EX1010). As a consequence, a POSITA would understand and consider it obvious that drop lines that carry less current should have smaller diameters than the higher-current carrying feeder cable, and therefore have a smaller diameter aperture within the connector that the aperture in the connector formed by the feeder cable. Therefore, a POSITA would find

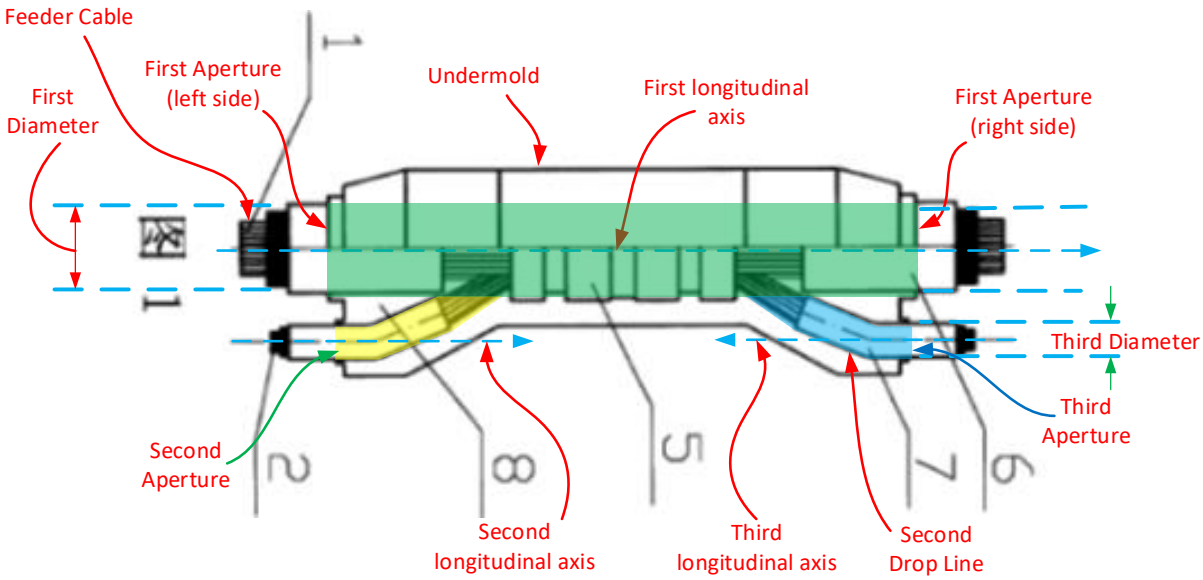
the claim language of the second diameter associated with the second aperture smaller than the first diameter associated with the first aperture to be obvious based on established electrical practices as well as the teachings in Shao (e.g., the dimensions visible in FIG. 1 reproduced above).

[264] For these reasons, a POSITA would have found the limitations in claim 8 to be obvious based on the Amphenol-Shao-Yamawaki combination.

9. Claim 10

> **The lead assembly of claim l, wherein the third longitudinal axis is substantially concentric with the second longitudinal axis, and substantially parallel with the first longitudinal axis.**

[265] Shao discloses, and shows in an illustration reproduced below, that the third longitudinal axis is substantially concentric with the second longitudinal axis, and substantially parallel with the first longitudinal axis. *See* EX1008, (5th-annotation), reproduced below.



EX1008, FIG. 1 (5th-annotation)

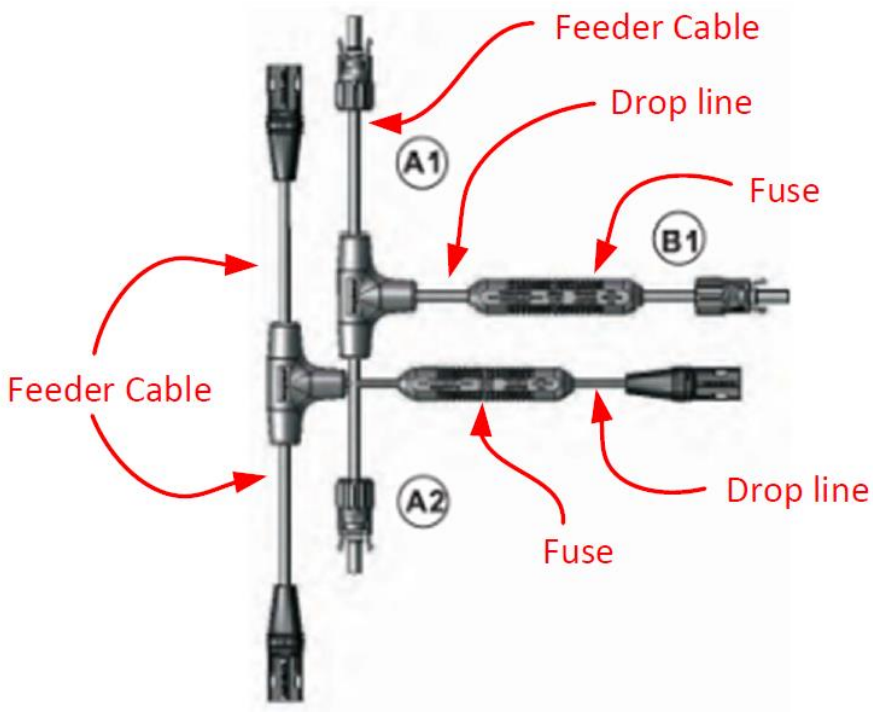
[266] As discussed in Shao, and would be understood by a POSITA, it is convenient for the drop lines to be arranged symmetrically and in parallel with the feeder cables in a solar installation, as this arrangement provides opportunities for cables to be routed in parallel and tied together so as to minimize the tangling and disorderly positioning of the cables in a large-scale installation. As discussed by Shao, "The branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear."

[267] For these reasons, a POSITA would have found the limitations in claim 10 to be obvious based on the Amphenol-Shao-Yamawaki combination.

10. Claim 11

The lead assembly of claim 1, wherein the drop line includes a fuse.

[268] Amphenol discloses, and shows in an illustration reproduced below, that the drop line includes a fuse. *See* EX1007, p. 13, top image (1st-annotation), reproduced below.



EX1007, p. 13, top image (1st-annotation)

[269] Additionally, Amphenol discloses, and shows in illustrations reproduced below, that a fuse may be connected to any cable in the assembly through connectors and/or including a fuse directly inline of any cable. *See* EX1007, p. 12, central image (a portion of which is reproduced below).



EX1007, p. 12, central image (right side)

[270] For these reasons, a POSITA would have found the limitations in claim 11 to be obvious based on the Amphenol-Shao-Yamawaki combination.

11. Claim 12

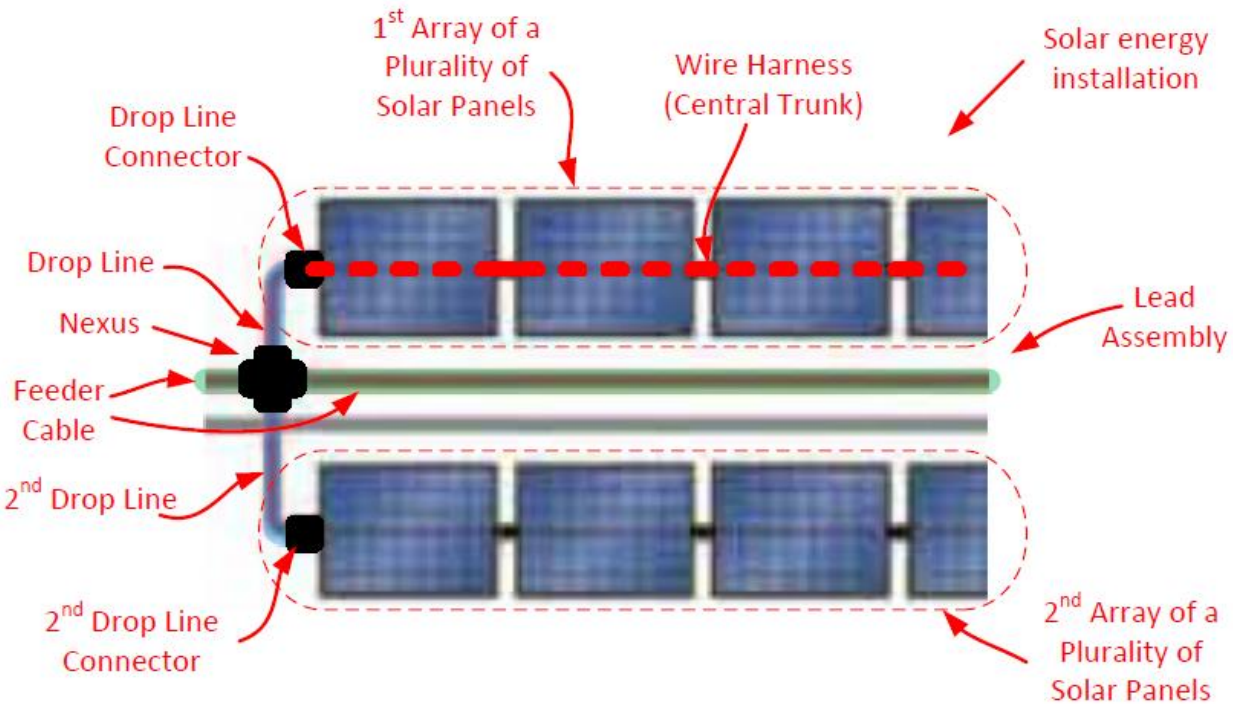
The lead assembly of claim 1, wherein said lead assembly combines power received from the plurality of solar panels and conducts that power directly to an inverter electrically connected to the feeder cable.

[271] The claim 12 limitations are the same as, at least equivalent to, or encompassed by the claim elements 1(a) and 1(b), and claim 7 that I addressed above. For the reasons presented above regarding the claim elements 1(a) and 1(b), and claim 7, which I incorporate here by reference, a POSITA would have found the claim 12 limitations to be obvious based on the Amphenol-Shao-Yamawaki combination.

12. Claim 13

The lead assembly of claim 1, wherein the second drop line terminates at a second drop line connector, the second drop line connector configured to connect with a central trunk of a second wire harness, the central trunk of the second wire harness having a plurality of branches the each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of solar panels.

[272] Amphenol discloses, and shows in an illustration reproduced below, that the second drop line terminates at a second drop line connector, the second drop line connector configured to connect with a central trunk of a second wire harness, the central trunk of the second wire harness having a plurality of branches that each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of solar panels. *See* EX1007, p. 5, middle image (Relief & 3rd-annotation), reproduced below. As discussed regarding the Ground 2, claim element 1(a), a POSITA would understand that the central trunk of Amphenol's wire harness inherently has a plurality of branches that each electrically connects to separate solar panel modules that together are a part of an array of a plurality of solar panels. *See id.*



EX1007, p. 5, middle image (Relief & 3rd-annotation)

[273] The diagrams provided by Amphenol enable a designer to design a cable harness system appropriate to match the solar array installation. In a case where the design includes a second wire harness associated with a second set of solar cells, a POSITA would understand that it is possible to configure elements, such as those shown in the illustration, along with other elements so as to enable a second drop line that terminates at a second drop line connector, where the second drop line connector is configured to connect with a central trunk of a second wire harness, and where the central trunk of the second wire harness has a plurality of branches where each are configured to electrically

connect to a separate solar panel contained in a second array of a plurality of solar panels. Amphenol provides flexible building blocks (cables, junctions, connectors, fuses, etc.) that are designed to allow assembly into many different configurations. A POSITA would appreciate that examples explicitly shown in Amphenol are representative, and not intended to be the only possible combination of components or combination of components from Amphenol.

[274] A POSITA would have been motivated to combine Amphenol with Shao and Yamawaki to preserve the range of overall system designs enabled by Amphenol by providing the improved reliability and performance which is associated with the detailed junction design and undermold/overmold designs disclosed in Shao and Yamawaki.

[275] For these reasons, a POSITA would have found the limitations in claim 13 to be obvious based on the Amphenol-Shao-Yamawaki combination.

13. Claim 14

The lead assembly of claim 13, wherein the lead assembly is configured to combine electrical power received from the array of solar panels and the second array of solar panels at the *nexus* and to deliver the combined electrical power to an inverter that is in electrical communication with the feeder cable.

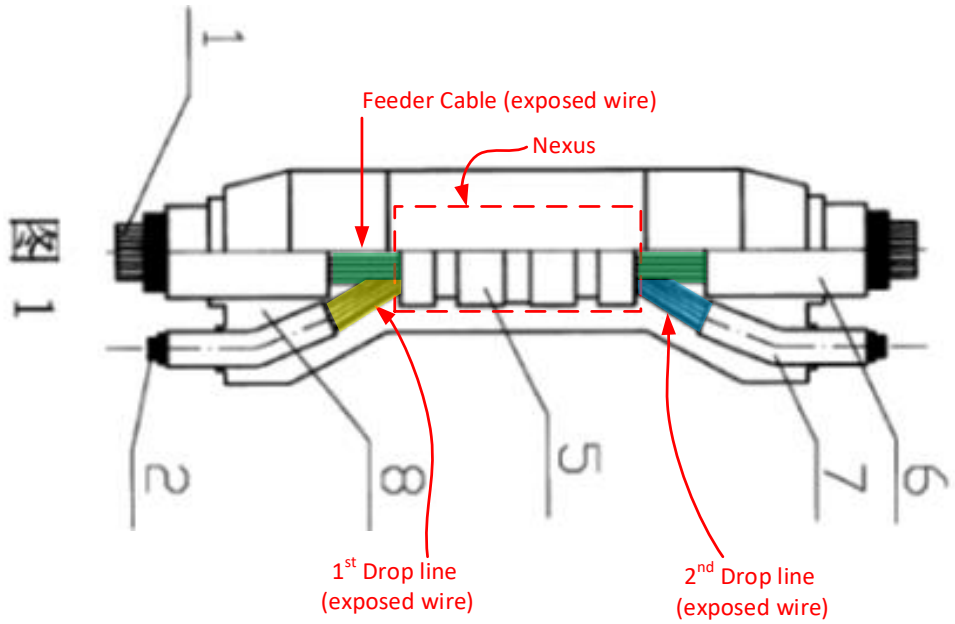
[276] The claim 14 limitations are the same as or at least equivalent to the claims 7, 12, and 13 limitations addressed above. For the reasons presented above regarding the claims 7, 12, and 13 limitations, which I incorporate here by reference, a POSITA would have found the claim 14 limitations to be obvious

based on the Amphenol-Shao-Yamawaki combination.

14. Claim 15

The lead assembly of claim 1, wherein the second drop line includes a section of exposed wire at the nexus so as to be electrically connected to the feeder cable.

[277] Shao discloses, and shows in an illustration reproduced below, that the second drop line includes a section of exposed wire (colored blue in the annotation below) at the nexus so as to be electrically connected to the feeder cable (colored green in the annotation below). *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

[278] As discussed above with regard to claims 2 and 3, any cable junction that combines multiple cables must include a process for removing the original

cable insulation from the cables to be joined at the point of joining the cables.

[279] For these reasons, a POSITA would have found the limitations in claim 15 to be obvious based on the Amphenol-Shao-Yamawaki combination.

15. Claim 16

The lead assembly of claim 1, wherein the drop line and the second drop line each includes a wire of between four (4) to eighteen (18) gauge.

[280] Amphenol discloses that branch cable (i.e., drop line) gauge may be selected from 8AWG(10.0mm^2), 10AWG(10.0mm^2), 12AWG(10.0mm^2), and 14AWG(10.0mm^2), which a POSITA would understand to include a wire between four and eighteen gauge. *See* EX1007, p. 13 ("Branch cable size checklist"). A POSITA would understand that an appropriate drop line gauge should be selected for the intended use. In particular, a POSITA would understand that the maximum amount of current to be carried by a cable is an important parameter in selection of the cable diameter and other cable parameters, such as the cable material and the insulation material. In particular, there are well-known guidelines for cable diameter selection for different amounts of maximum current. For example, Table 310.16 of the NEC 2002, titled "Allowable Ampacities of Insulated Conductors Rated 0 Through 2000 Volts..." See EX1010, p. 149, reproduced below. This table is a wire ampacity size table with which any POSITA would be familiar and provides a guide for what gauge wire is appropriate for different ampacities of insulated conductors.

See id. Table 310.16 shows that wire gauges between 18 AWG and 4 AWG are expected to carry current from 14A to 95A at temperatures up to 90°C, and up to 70A at temperatures up to 60°C. *See id*. A POSITA would understand how to find and use engineering standards and guides, such as the NEC 2002, to make decisions about the diameter of the wire needed for different sections of a solar installation. Similar tables are available within the NEC 2002 with information on selection for different voltages, and for resistances.

Size AWG or kcmil	Temperature Rating of Conductor (See Table 310.13.)						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18	—	—	14	—	—	—	—
16	—	—	18	—	—	—	—
14*	20	20	25	—	—	—	—
12*	25	25	30	20	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	190	230	255	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000

EX1010, Table 310.16

[281] For these reasons, a POSITA would have found the limitations in claim 16 to be obvious based on the Amphenol-Shao-Yamawaki combination.

16. Claim 17

The lead assembly of claim 16, wherein the feeder cable includes a wire of between 250 MCM to 1000 MCM.

[282] A POSITA would understand that the abbreviation "MCM" stands for thousands of circular mils, which defines wire sizes. A typical 250 MCM cable would have a diameter of more than 1cm, and a 1000 MCM cable would have a diameter near 2.5 cm.

[283] The table 310.16 (reproduced above regarding claim 16) includes ampacity values for cables with 250 or 1000 MCM diameter; these are expected to carry current from 215A to 455A. Other than diameter and current carrying capacity, there are no differences between cables from 18 AWG to 1000MCM. A POSITA would understand how to find and use such guides to make decisions about the diameter of the wire needed for different sections of a solar installation, and to select such cables from the catalogs of suitable vendors. Similar tables are available with information on selection for different voltages, and for resistances. Therefore, a POSITA would understand that the selection of feeder cable size, in the range of 250 MCM to 1000 MCM is an obvious design choice in view of Amphenol.

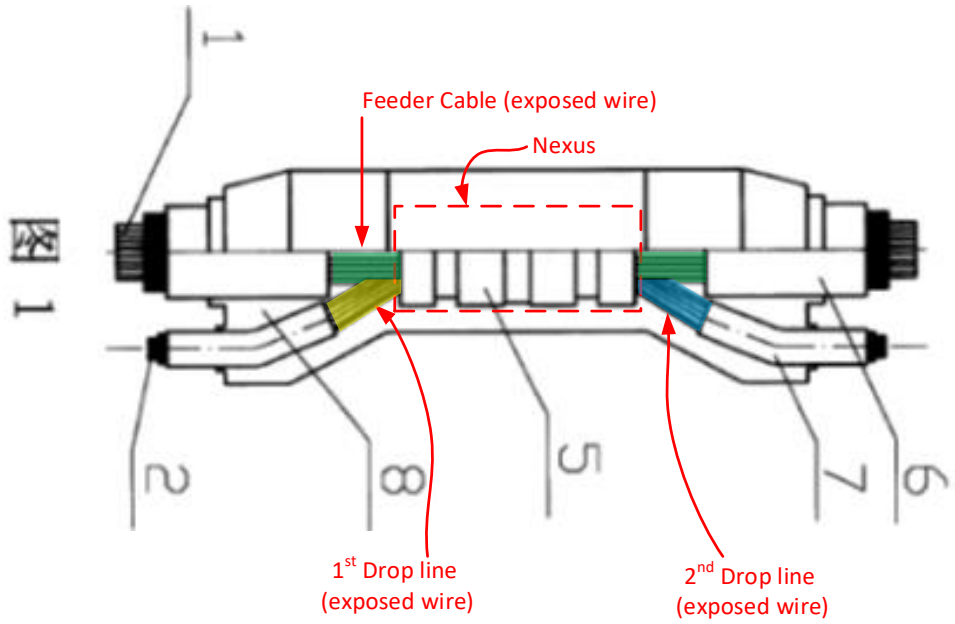
[284] For these reasons, a POSITA would have found the limitations in claim 17

to be obvious based on the Amphenol-Shao-Yamawaki combination.

17. Claim 18

The lead assembly of claim 15, wherein the electrical coupling between the feeder cable, the drop line and the second drop line at the nexus is secured with at least one of a compression lug, a solder connection, a splice, and a crimp.

[285] Shao discloses, and shows in an illustration reproduced below, that "an elongated copper C-shaped clamp is used to form a K-shaped branch connector 5," which maintains an engagement between the feeder cable and the drops lines at the nexus. EX1008, p. 6:17-18 and EX1008, FIG. 1 (1st-annotation), below. A POSITA would recognize that a C-shaped clamp used to form an electrical connector as disclosed in Shao is equivalent to a "crimp."



EX1008, FIG. 1 (1st-annotation)

[286] As described by Shao, "The K-shaped branch connector is an elongated C-

shaped clamp made of a copper material. The joint is formed by symmetrical overlapping and crimping of one trunk conductor and two branch-line conductors." EX1008, 5:10-13. Therefore, Shao discloses the use of crimping to form the nexus.

[287] For these reasons, a POSITA would have found the limitations in claim 18 to be obvious based on the Amphenol-Shao-Yamawaki combination.

18. Claim 19

The lead assembly of claim 1, wherein the undermold is applied by injection molding.

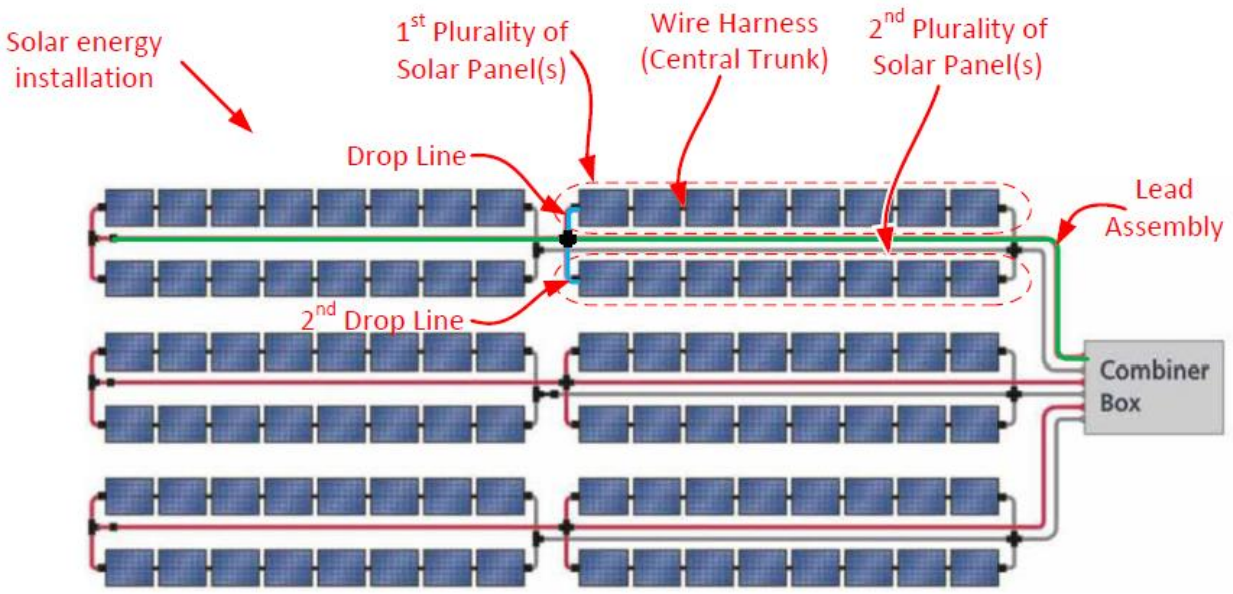
[288] Shao discloses a feeder cable's electrical coupling to drop lines at a nexus that is covered by a sheath made of injection molding material, which is an undermold that fully encases the nexus. *See* EX1008, 5:15-20. A POSITA would recognize that an injection molded sheath (i.e., an undermold), as taught by Shao, encases the exposed cables and the metal clamp holding them together is better protected from damage and/or exposure (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed above).

[289] For these reasons, a POSITA would have found the limitations in claim 19 to be obvious based on the Amphenol-Shao-Yamawaki combination.

19. Claim 21

Preamble. A solar power system comprising:

[290] Amphenol discloses a solar energy installation (i.e., a solar power system). *See* EX1007, p. 5, middle image (1st-annotation), below.



EX1007, p. 5, middle image (1st-annotation)

[291] For these reasons, a POSITA would have found the limitations in claim 21(Preamble) to be obvious based on Amphenol.

a. a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness to form a first solar array;

[292] Amphenol discloses a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness to form a first solar array. *See* EX1007, p.6, middle image (1st-annotation), above.

[293] For these reasons, a POSITA would have found the limitations in claim 21(a) to be obvious based on Amphenol.

b. a lead assembly comprising:

[294] The claim 21(b) limitations are the same as or at least equivalent to the claim 1(Preamble) limitations addressed above. For the reasons presented above

regarding the claim 1(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b) limitations to be obvious based on Amphenol.

i. a drop line electrically connected to a central trunk of the wire harness and configured to receive power from the plurality of solar panels;

[295] As discussed above with regard to the claim 1(a) limitations, Amphenol discloses that the drop line connector is connected to a central trunk of a wire harness, and the central trunk of the wire harness inherently has a plurality of branches that each electrically connect to separate solar panels that together are a part of an array of a plurality of solar panels. For the reasons presented above regarding the claim 1(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(i) limitations to be obvious based on Amphenol.

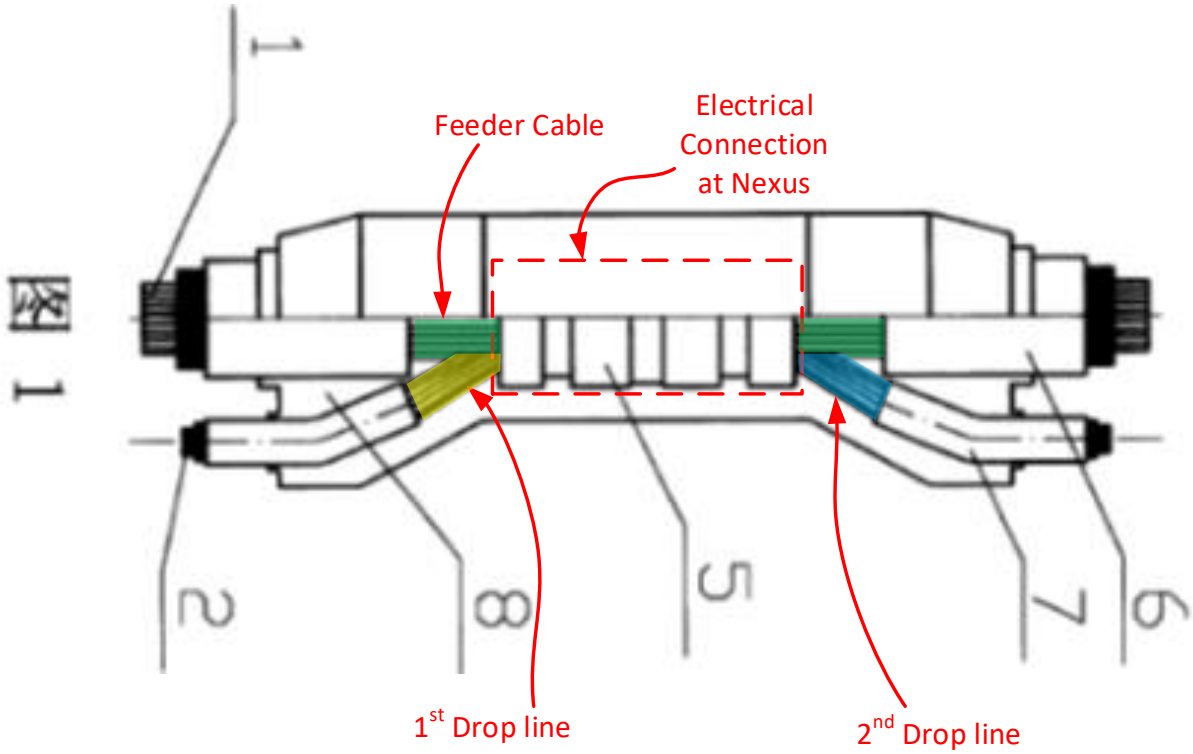
ii. a second drop line electrically connected to a central trunk of a second wire harness and configured to receive power from a plurality of solar panels in a second solar array;

[296] As discussed above with regard to the claim element 1(c)(iii) and claim 13 limitations, the Amphenol-Shao-Yamawaki combination discloses a second drop line electrically connected to a central trunk of a second wire harness and configured to receive power from a plurality of solar panels in a second solar array. For the reasons presented above regarding the claim element 1(c)(iii) and claim 13 limitations, which I incorporate here by reference, a POSITA would

have found the claim 21(b)(ii) limitations to be obvious based on the Amphenol-Shao-Yamawaki combination.

iii. a feeder cable, the feeder cable electrically connected to the drop line and the second drop line at a nexus; and

[297] Shao discloses a feeder cable electrically connected to the drop line and the second drop line at a nexus. *See* EX1008, FIG. 1 (6th-annotation), below.



EX1008, FIG. 1 (6th-annotation)

[298] As discussed above with regard to the claim elements 1(b) and 1(c)(iii) and claim 13 limitations, the Amphenol-Shao-Yamawaki combination discloses a second drop line electrically connected to a central trunk of a second wire harness and configured to receive power from a plurality of solar panels in a

second solar array. For the reasons presented above regarding claim elements 1(b) and 1(c)(iii) and claim 13 limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(iii) limitations to be obvious based on the Amphenol-Shao-Yamawaki combination.

iv. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[299] The specification of the '153 Patent does not define the term "primary mold" or detail about how the primary mold "substantially seals" the nexus because no description of a sealing function of the primary mold or undermold was included in the original disclosure. *See* EX1001, generally. Based on illustrations in the '153 Patent and the plain and ordinary meaning of the expression "primary mold" in the context of the claim, it is my opinion that a POSITA would have understood the term "primary mold" in the '153 Patent claims to mean a " material molded over a piece or part that seals against environmental factors." *See* EX1001, FIGS. 48, 54, 55, 60 and generally. This definition is consistent with a definition adopted by the Order in the parallel proceedings before the International Trade Commission involving the '153 Patent. *See* EX1017, p.36. That construction is informative for establishing how a POSITA would understand the terms in the context of the '153 Patent claims.

[300] Thus, the claim 21(b)(iv) limitations are the same as or at least equivalent to the claim element 1(c) and claim 18 limitations addressed in Ground 2. For the reasons presented in Ground 2 for the claim element 1(c) and claim 18 limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(iv) limitations to be obvious based on the Amphenol-Shao-Yamawaki combination.

> **(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture;**
>
> **(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture and**
>
> **(3) a third aperture extending partially through the primary mold and having a third diameter smaller than the first diameter, wherein the second drop line extends into the third aperture.**

[301] The claim 21(b)(iv)(1-3) limitations are the same as or at least equivalent to the claim 1(c)(i)-(iii) limitations addressed in Ground 2. For the reasons presented in Ground 2 for the claim 1(c)(i)-(iii) limitations, which I incorporate here by reference. Although the claim elements 21(b)(iv)(2) and 21(b)(iv)(3) refer to "smaller" diameters, in contrast to claim elements 1(c)(ii) and 1(c)(iii), which refer to "different" diameters, reciting that two apertures have different diameters implies a comparison where one aperture must necessarily have a smaller diameter than the other. For these reasons and the ones presented

regarding the claim 1(c)(i)-(iii) limitations, a POSITA would have found the claim 21(b)(iv)(1-3) limitations to be obvious based on the Amphenol-Shao-Yamawaki combination.

20. Claim 22

The solar power system of claim 21, wherein the feeder cable is directly electrically connected to a component selected from the group consisting of a trunk buss jumper, an inverter, a connection unit, a recombiner, and a disconnect unit.

[302] The claim 22 limitations are the same as or at least equivalent to the claim 6, claim 12, and claim 14 limitations addressed above. For the reasons presented above regarding the claim 6, claim 12, and claim 14 limitations, which I incorporate here by reference, a POSITA would have found the claim 22 limitations to be obvious based on Amphenol, Shao, and Yamawaki.

21. Claim 23

The solar power system of claim 21, further comprising a secondary mold surrounding the primary mold and forming an undermold-overmold interface at an outer surface of the primary mold.

[303] The claim 23 limitations are the same as or at least equivalent to the claim 1(d) limitations addressed above in this Ground 2. For the reasons presented above for the claim 1(d) limitations, which I incorporate here by reference, a POSITA would have found the claim 23 limitations to be obvious based on the Amphenol-Shao-Yamawaki combination.

22. Claim 24

Preamble. A solar power system comprising:

[304] The claim 24(Preamble) limitations are the same as or at least equivalent to the claim 1(Preamble) or claim 21(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) or claim 21(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(Preamble) limitations to be obvious based on Amphenol.

a. a plurality of solar panels electrically coupled by a wire harness to form a first solar array;

[305] The claim 24(a) limitations are the same as or at least equivalent to the claim 21(a) limitations addressed above. For the reasons presented above regarding the claim 21(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(a) limitations to be obvious based on Amphenol.

b. a lead assembly comprising:

[306] The claim 24(b) limitations are the same as or at least equivalent to the claim 1(Preamble) or claim 21(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) and/or claim 21(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b) limitations to be obvious based on Amphenol.

i. a first drop line electrically connected to the wire harness and configured to receive power from the plurality of solar panels;

[307] The claim 24(b)(i) limitations are the same as or at least equivalent to the claim element 1(a) limitations addressed above. For the reasons presented above regarding the claim element 1(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(i) limitations to be obvious based on Amphenol.

ii. a feeder cable, the feeder cable electrically connected to the drop line at a nexus;

[308] The claim 24(b)(ii) limitations are the same as or at least equivalent to the claim element 1(b) limitations addressed above. For the reasons presented above regarding the claim element 1(b) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(ii) limitations to be obvious based on Amphenol.

iii. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[309] The claim 24(b)(iii) limitations are the same as or at least equivalent to the claim 1(c) or claim 18 limitations addressed above. For the reasons presented above regarding the claim 1(c) and/or claim 18 limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iii) limitations to be obvious based on Amphenol and Shao.

(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis;

[310] The claim 24(b)(iii)(1) limitations are the same as or at least equivalent to the claim element 1(c)(i) limitations addressed above. For the reasons presented above regarding the claim element 1(c)(i) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iii)(1) limitations to be obvious based on Amphenol and Shao.

(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture along a second longitudinal axis; and

[311] The claim 24(b)(iii)(2) limitations are the same as or at least equivalent to the claim element 1(c)(ii) limitations addressed above. For the reasons presented above regarding the claim element 1(c)(ii) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iii)(2) limitations to be obvious based on Amphenol and Shao.

iv. a second drop line electrically connected to a second wire harness that connects to a plurality of solar panels, the second drop line electrically connected to the feeder cable at the nexus fully encased by the primary mold, wherein the second drop line extends into a third aperture defined by the primary mold along a third axis.

[312] The claim 24(b)(iv) limitations are the same as or at least equivalent to the claim element 1(c)(iii) limitations addressed above. For the reasons presented

above regarding the claim element 1(c)(iii) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iv) limitations to be obvious in view of Amphenol as modified by Shao.

[313] In sum, for all of the reasons discussed above regarding Ground 2, it is my opinion that a POSITA would have found claims 1-3, 5-19, and 21-24 to be obvious in view of Amphenol, Shao, and Yamawaki, and therefore should be found invalid under 35 U.S.C. § 103 based on Amphenol, Shao, and Yamawaki.

C. Ground 3: Claim 20 is unpatentable under 35 U.S.C. § 103 as obvious in view of Amphenol, Shao, Yamawaki, and Tamura.

(i) Motivation To Combine Amphenol, Shao, Yamawaki, and Tamura

[314] A POSITA would have been motivated to combine Amphenol, Shao, Yamawaki, and Tamura (i.e., the "Amphenol-Shao-Yamawaki-Tamura combination") because all four references discuss the design of cable junction elements that can be used to combine electrical power from a distributed array of solar cells that is convenient, reliable, flexible, and low-cost. Amphenol discloses a variety of cable junction geometries and provides a process for users to select combinations that are appropriate for their system configuration. *See* EX1007, pp. 5 and 10-16. Shao discloses designs and manufacturing methods that can be used for joining the main cables and drop lines and providing insulation and molding to protect the junctions. *See* EX1008, 5:31-34, 6:18-30,

and 6:40-7:1. Yamawaki discloses photovoltaic modules that may be arranged in various ways to overcome challenges and support the design of a photovoltaic panel array, such as on a home solar energy installation, in addition to improvements to branch junctions that include a molded body (i.e., an undermold) covered by a cover member (i.e., an overmold). *See* EX1006, 7:54-8:11, 10:19-22 and FIG. 9B. Likewise, Tamura is generally directed to cable assemblies that provide "high waterproofing performance by virtue of a double waterproof effect." EX1009, ¶17. The disclosure of Tamura is in the same field of electrical connectors as Amphenol, Shao, and Yamawaki, is thus analogous prior art, and discloses a "Cable branch molding method." *See id*., ¶3. Tamura also discloses a double-molded structure that provides improved protection from water. *See id*., ¶17. Accordingly, all four references are in the same field of endeavor of electrical connectors and power wiring. Further, Tamura addresses some of the same problems as the '153 Patent, such as the ability "for a plurality of solar arrays are electrically coupled together," and "arranging multiple solar battery modules comprising a plurality of solar 5 battery cells on a roof or on top of a building, and connecting the solar battery modules by means of cables." *See id*., ¶2. Therefore, Tamura is analogous prior-art to the '153 Patent.

[315] As described in detail below, Tamura provides further improvements to the

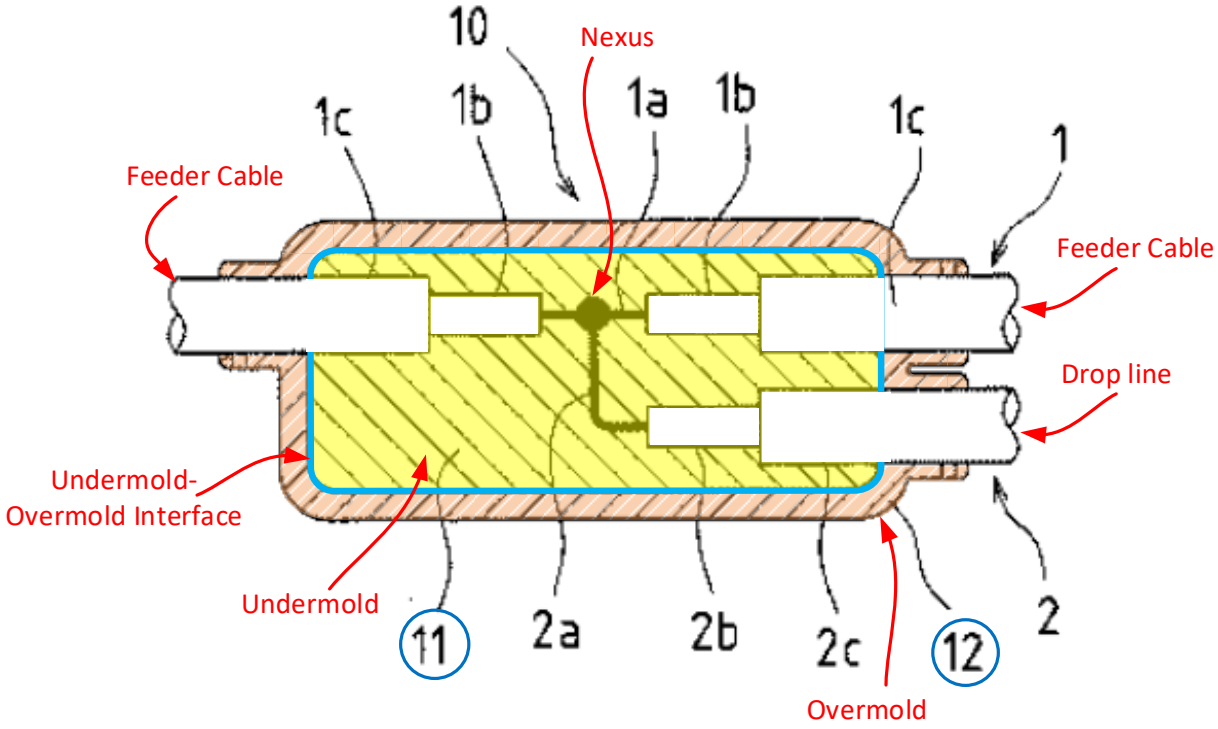
Amphenol-Shao combination by providing a 2-layer molding process that Tamura explains will offer better reliability and performance because of the selection of "PVC resins" for several of the layers of the assembly, and the use of an inner mold part and an outer mold part which provides a "double waterproof effect." *See id*., ¶17.

[316] Although Tamura, like Amphenol, Shao, and Yamawaki, does not explicitly refer to the cables and wiring assemblies as "drop lines," "a feeder cable," "lead assembly," "a wire harness," or "a central trunk," as discussed above, a POSITA would understand that the disclosed cables and wiring assemblies are equivalent and/or analogous to drop lines, a feeder cable, a lead assembly, a wire harness, and/or a central trunk. See 'C(i) Motivation to Combine Amphenol and Shao,' discussed above.

[317] A POSITA would be motivated to combine the manufacturing methods of Shao and Yamawaki with Tamura, and specifically the addition of the two molding steps of Tamura to the design of Shao, to achieve further improvements in reliability and performance, and to use these detailed designs, processes, and materials, to build the entire catalog of wiring harness components disclosed by Amphenol.

[318] Tamura is JP Patent 4080633, published on April 23, 2008, and is titled "Cable Branch Molding Method." *See id*., cover page. Tamura describes, "[a]

method of molding a cable branch portion, which is a method for molding a section where a conductor of a branch cable is connected to a connector of a trunk cable…" using a process with an "inside molded part" is formed over the connection between the branch cable and the trunk cable, and a "outer mold part" is formed over the inner mold part, covering the inner mold. *See id.*, p. 2, ln 6-25. An illustration from Tamura is provided to help describe the disclosure:



EX1009, FIG. 1 (1st-annotation)

[319] As described by Tamura, "PE is used for the resin of the inside molded portion 11. The inside molded portion 11 adheres to outer circumferential surfaces of the conductors 1a, 2a of the trunk cable 1 and the branch cable 2, and the 25 insulators 1b, 2b (also including a portion of the sheath materials 1c,

2c) of the cables…PVC is used for the resin of the outside molded portion 30 12. The outside molded portion 12 adheres to the outer circumferential surfaces of the sheath materials 1c, 2c of the trunk cable 1 and the branch cable 2…According to this embodiment, the same resin (PE) as that of the insulators 1b, 2b of the CV cable is thus used as the resin of the inside molded portion 11, which therefore improves adhesion between the inside molded portion 11 and the insulators 1b, 2b. Additionally, the same resin (PVC) as that of the sheath materials 1c, 2c of the CV cable is used as the resin of the outside molded portion, which therefore also improves adhesion between the outside molded portion 12 and the sheath materials 1c, 2c. This makes it possible to achieve high waterproofing performance by virtue of a double waterproofing effect." *See id*., ¶¶15-17.

[320] Tamura explains: "…the present invention may also be applied to molding of branch portions for various types of cables used for connecting electrical devices such as modules for snow melting purposes and modules for tape heaters." *See id*., ¶25. Further, Tamura, in the same field of electrical connectors as Amphenol and Shao, discloses a "Cable branch molding method." *See id*., ¶3. Tamura also discloses a double-molded structure that provides improved protection from water. *See id*., ¶17.

[321] In addition, to the combination of Amphenol, Shao, and Yamawaki

discussed above in Ground 2, the POSITA would further be motivated to combine the solar power system and connectors as taught by Amphenol and modified by Shao and Yamawaki with the multi-layered protective arrangement taught by Tamura in order to provide a compact, layered casing that better protects the solar power system branch connectors against the elements. Further, a POSITA would have an expectation of success in making the Amphenol-Shao-Yamawaki-Tamura combination since these references complement one another by further protecting and strengthening solar power system branch connections. Amphenol, Shao, Yamawaki, and Tamura are not cumulative references because Amphenol focuses on cable assemblies, connectors, tools, and accessories, Shao addresses the details of the cable junctions, Yamawaki covers the different and broader aspects of solar power installations, and Tamura teaches the further benefits of applying the overmolding using injection molding for high water proofing performance. *See* EX1007, p.2; EX1008, 4:35-37; EX1006, 2:45-3:15, EX1009, ¶23.

[322] Specifically, Tamura goes on to explain that the double-molding described in this disclosure can be applied broadly, "…the present invention may also be applied to molding of branch portions for various types of cables used for connecting electrical devices such as modules for snow melting purposes and modules for tape heaters." *See id*., ¶25. First, Tamura discloses protecting

power cable joints using an injection-molded outer mold over an inner mold. EX1009, ¶23. Second, Tamura teaches that better adhesion is achieved by an injection molded PVC outermold over a polyethylene (PE) undermold, which provides better waterproofing. EX1009, ¶9. Thereby, Tamura is explicitly encouraging POSITAs to apply the details disclosed in Tamura broadly, which would motivate and indicate likely success to a POSITA.

[323] Accordingly, a POSITA would have been motivated to combine the Amphenol-Shao-Yamawaki combination with Tamura. This combination would further add the benefits of Tamura, such as adding an injection-molded outer mold part 12 (i.e., an overmold) over an inner mold part 11 (i.e., an undermold). EX1009, ¶14

[324] Further, a POSITA would have understood to achieve these advantages, the selection of "PVC resins" for several of the layers of the assembly, and the use of an inner mold part and an outer mold part disclosed by Tamura could be successfully applied to the modified harness of the Amphenol-Shao combination. The precise technical combination and modifications are described further below.

1. Claim 20

The lead assembly of claim 1, wherein the overmold is applied by injection molding.

[325] Tamura discloses applying an injection molded overmold over an undermold

of a branch cable connection to provide an added layer of waterproofing. *See* EX1009, ¶11, 15-17. In particular, Tamura discloses adding an injection-molded outer mold part 12 (i.e., an overmold) over an inner mold part 11 (i.e., an undermold). *See* EX1009, ¶14. As discussed above regarding Ground 2, Claim 1(c), Shao discloses a feeder cable's electrical coupling to drop lines at a nexus that is covered by a sheath made of injection molding material, which is an undermold that fully encases the nexus. *See* EX1008, 5: 16-20. It would have been obvious to a POSITA to rely on the teaching of Shao to provide the design of the cable junction to provide an injection-molded undermold to encase the exposed cables and the metal clamp holding them together and protect those elements from damage and/or exposure (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed above). In addition, it would have been obvious to a POSITA to add an injection molded overmold, over the injection-molded undermold taught by Shao, for added protection against environmental elements with improved adhesion between the molded layers, as taught by Tamura (*see* 'D(i) Motivation to Combine Amphenol, Shao, Yamawaki, and Tamura' further discussed above).

[326] For these reasons, a POSITA would have found the claim 20 limitations to be obvious based on the Amphenol-Shao-Yamawaki-Tamura combination.

* * *

[327] In sum, for all of the reasons discussed above regarding Ground 3, it is my opinion that a POSITA would have found claim 20 to be obvious in view of the Amphenol-Shao-Yamawaki-Tamura combination, and therefore should be found invalid under 35 U.S.C. § 103 based on Amphenol, Shao, Yamawaki and Tamura.

D. Ground 4: Claims 1-3, 5, 8-11, 13, 15-23, and 24 are unpatentable under 35 U.S.C. § 103 as obvious in view of Amphenol, Shao, and Tamura.

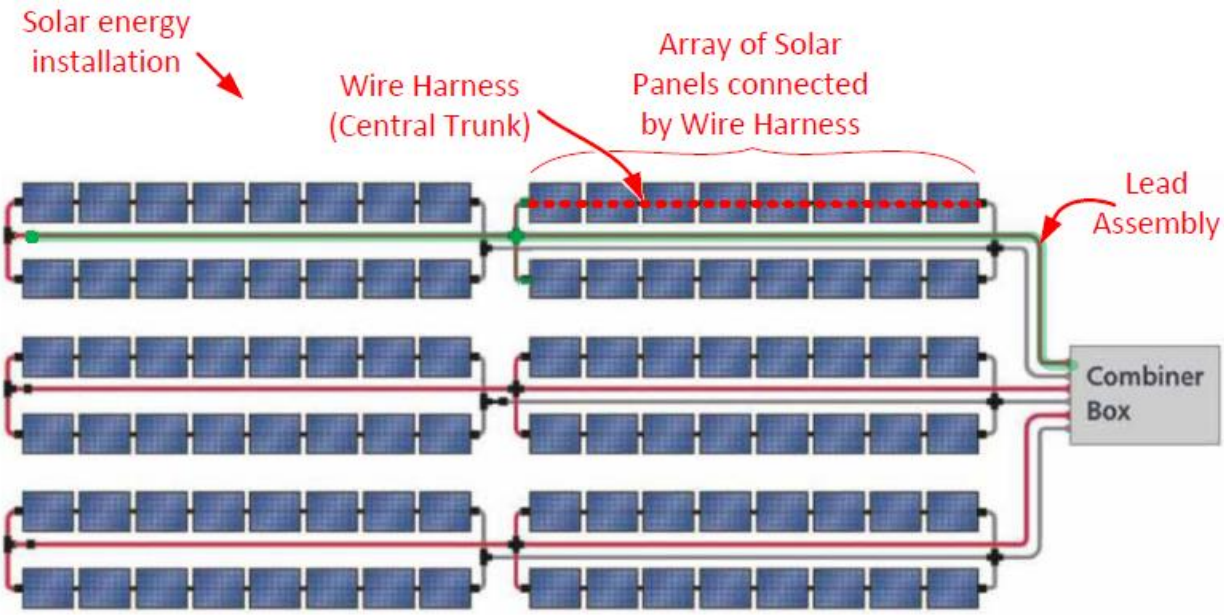
(i) Motivation To Combine Amphenol, Shao, and Tamura

[328] A POSITA would have been motivated to combine Amphenol with Shao and Tamura (i.e., the "Amphenol-Shao-Tamura combination") because the references address the general problem of providing convenient, flexible, reliable, and low-cost wiring assemblies with branching junctions. Amphenol is concerned with wire assemblies, cable junctions, connectors, in-line fuses, and other components to be used for combining and distributing power from elements of a solar array installation. See EX1007, generally. Shao is also concerned with the field of wires (i.e., cables) and more specifically the detailed design of a cable junction to be used for power distribution. See EX1008, generally. Tamura, like Shao, relates to the field of solar power cables and more specifically the molding of the branch junctions used for power

distribution. EX1009, ¶3. These references discuss the design of cable junction elements that can be used to combine or distribute electrical power. The important details disclosed in Amphenol, Shao, and Tamura relate to the formation of a reliable electrical contact between different cables, protecting the connection from environmental factors and damage from handling, and fabricating the electrical contact elements in a way that reduces cost and simplifies the assembly and maintenance of the power facilities. Amphenol focuses on solar arrays, and Shao and Tamura focused on power distribution, but the underlying mechanics, materials, assembly processes, molding processes, and other details are similar such that a POSITA would have been motivated to consider both publications in combination. Fundamentally, within a cable junction, the biggest difference between power combining and power distribution is the direction in which that electrons are moving in some parts of the junction. Based on well-known practices in the field of solar power systems, such as taught in the PSE textbook (EX1011) and the NEC 2002 (EX1010), a POSITA would understand how to apply the teaching of Shao to the wiring assembly disclosed by Amphenol to produce systems suitable for solar power systems with the benefits sought in both references.

[329] Amphenol is a product catalog representing a broad array of electrical products that can be used to make electrical connections or junctions between

cables and other elements in an electrical system. The catalog states "Amphenol designs, manufactures and markets electrical, electronic and fiber optic connectors, interconnect systems, and coaxial and specialty cables…and provides solutions for customers in the automotive, broadband, industrial, information technology and data communications, military and aerospace, mobile devices and mobile networks markets." EX1007, p. 2. This includes cables, cable assemblies, and other elements specifically for solar installations. *See id.*, pp. 2-16, middle image (1st-annotation), reproduced below.



EX1007, p. 5, middle image (1st-annotation)

[330] Amphenol specifically illustrates and provides specifications for cable installations for solar cell arrays including solar panels, wiring harnesses, and lead assemblies each with a feeder cable, drop lines, and connectors. *See id.,*

e.g., pp. 3-13. In Amphenol, the lead assemblies are referred to as "junction cable assemblies," and a variety of such assemblies are disclosed. *e.g.*, pp. 5 and 13. Each of the variety of disclosed junction cable assemblies address the general problem of providing convenient, flexible, reliable, and low-cost wiring connections for solar cell installations. *See id.*, p. 21, top image. Also, in Amphenol, the lead assemblies include a feeder cable, which is referred to as a "main cable," and drop lines, which are referred to as "branch cables." *See id*., p. 21, generally. From well-known practices in the field of solar power systems (e.g., EX1010) and illustrations in Amphenol (e.g., EX1007, p. 5, middle image reproduced above), a POSITA would understand that a solar power installation includes a number of individual solar panels and a set of cables that connect the solar panels to a common terminal at the inverter, and that this set of cables would include wiring assemblies that provide a convenient conductive structure for making electrical connections with individual solar panels in large solar power installations. Also, from well-known practices in the field of solar power systems, a POSITA would understand that such cables need to be joined together at a single terminal to the inverter or alternatively be brought together at an intermediate combiner box (*e.g.,* EX1010, Figure 690.1(B), p. 544).

[331] Although the '153 Patent uses particular terminology for various elements of its wiring assemblies (e.g., "lead assembly," "feeder cable," drop line," and

"wire harness"), a POSITA at the time the '153 Patent was filed would understand that such terminology is not universal within the industry. For example, neither the NEC 2002 nor the PSE textbook uses these terms. *See* EX1010, Article 690, pp. 543-552 and EX1011, generally. A POSITA familiar with the design of solar power systems and the selection of suitable electrical wiring and connectors (e.g., EX1010, 690.8 Circuit Sizing and Current, p. 546), including photovoltaic wiring and connectors, would understand that the terms "wire harnesses" and "lead assemblies" both refer to wiring assemblies used for organizing and facilitating electrical connections within electrical power systems. A POSITA familiar with the design of solar power systems and the selection of suitable electrical wiring and connectors (e.g., EX1010) would understand that the roles of "wire harnesses" and "lead assemblies" differ between devices used for power combining or power distribution, but the materials and dimensions of their construction are the same and/or analogous. The distinctions in the role played by these cable assemblies do not change the materials and dimensions of wiring assemblies used in power gathering or power distribution systems. For example, the Yamawaki reference, which like the '153 Patent relates to photovoltaic generation wiring and systems, uses the terms "wiring apparatus," "trunk cable," "branch cable," and "branch junctions," for electricity conducting elements that the '153 Patent calls the

"lead assembly," "feeder cable," "drop line," and "joint," respectively. *See* EX1006, 9:57-10:19. Similarly, the Solon741 reference (which has the same inventor as the '153 Patent), which like the '153 Patent relates to photovoltaic generation wiring and systems, uses the terms "wire harness," "trunk," "branch," and "cross joints," for electricity conducting elements that the '153 Patent calls the "lead assembly," "feeder cable," "drop line," and "joint," respectively. *See* EX1005, ¶29.

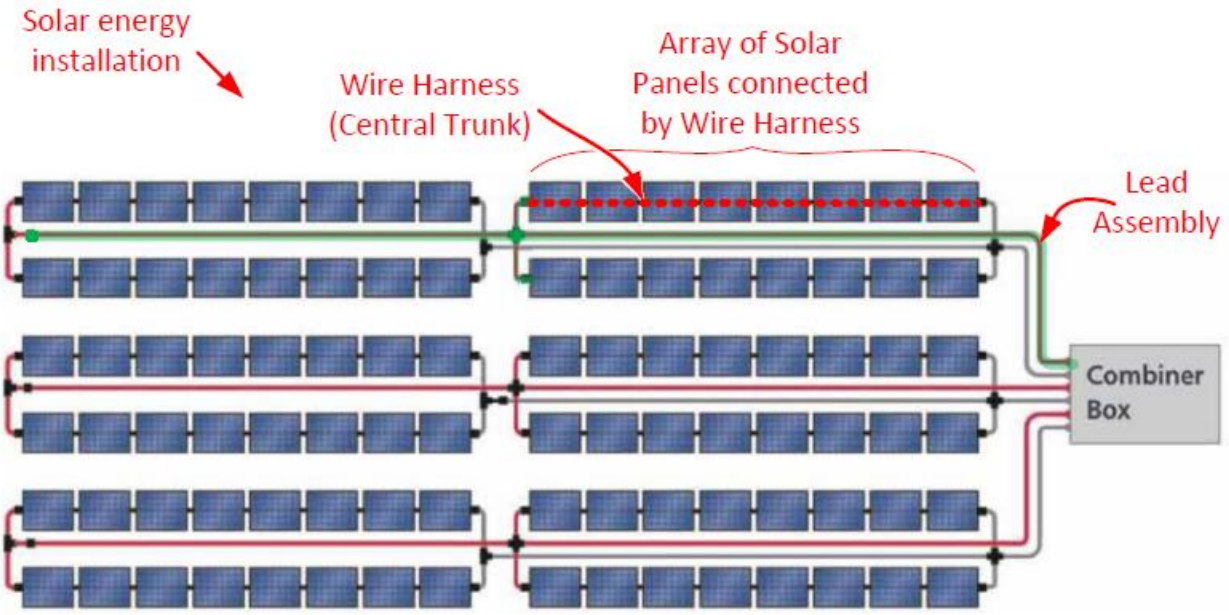
[332] Despite the variations in terminology commonly used in the field of photovoltaic power systems, a POSITA would appreciate that the basic electrical wiring and connector elements perform similar functions and have similar requirements. Solar power electrical wiring and connector assemblies all include junctions between cables, and serve to merge or divide current from a power generation system or a power distribution system. For example, the lowest voltage wires may feed or drop into a larger connecting line that carries the higher voltage to another larger line that receives voltage from multiple connecting lines. Accordingly, a POSITA familiar with the design of solar power systems (e.g., EX1010 and EX1011) would have understood that the solar array includes a hierarchy of branches where the wires and connections can have different names despite operating in the same manner in the same hierarchy.

[333] A POSITA familiar with the design of solar power systems (e.g., EX1010 and EX1011) would have understood that main cables supplying power and carrying higher currents may be called "trunks," "trunk cables," "trunk conductors," "main cables," "feeder cables," or the like. Similarly, the smaller diameter cables branching off a main cable and carrying lower currents may be called "branches," "branch cables," "branch conductors," "branch lines," "drop lines," or the like. Also, wiring assemblies that join electrical components and/or wires may be called "wire harnesses," "lead assemblies," "wiring apparatus," or the like depending upon local and/or regional parlance. A POSITA would understand that the only significant difference between cable junctions used for merging or dividing current flow is the direction of the current flows into or out of the junctions. With knowledge of the NEC 2002, a POSITA would have understood that it is important to use appropriately sized cables for the intended application, have very good electrical connections within these junctions, and provide protective moldings to prevent the effects of external environments from causing corrosion or failure of the cables and junctions.

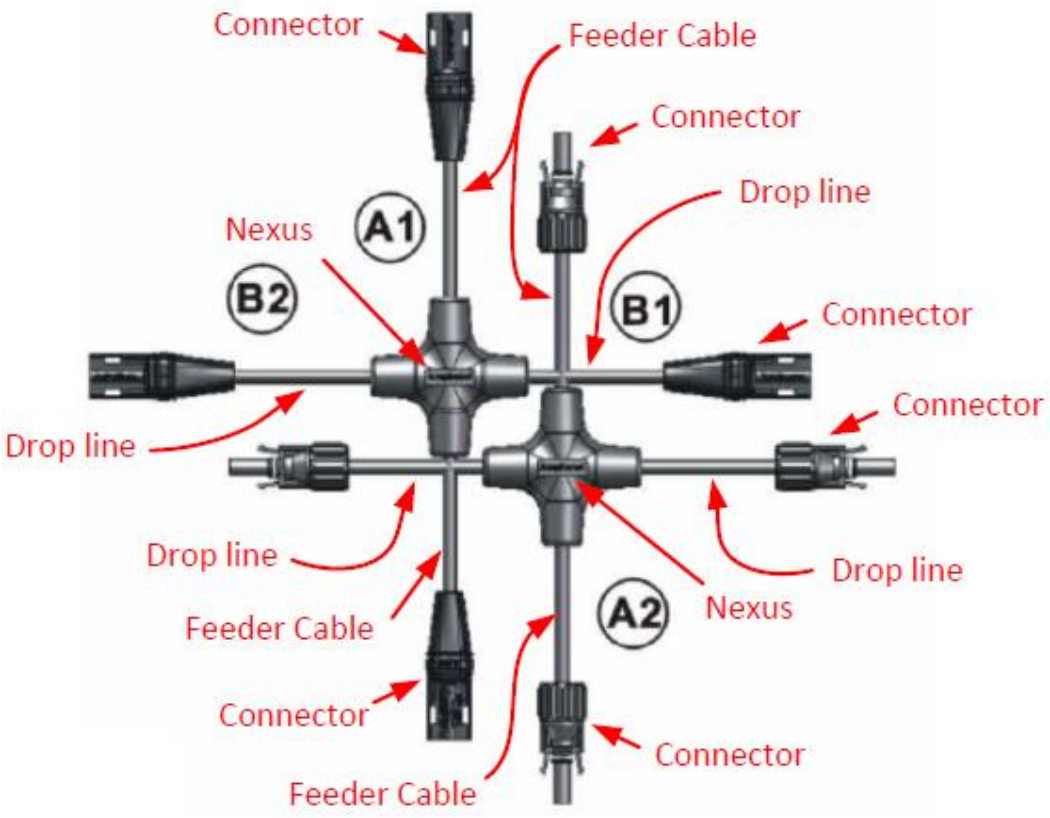
[334] A POSITA familiar with the design of solar power systems (e.g., EX1010 and EX1011) would further understand that a combiner box is one example of a convenient means for merging current from several lead assemblies to a single

cable that is applied to the terminal of the inverter. Such a POSITA would also understand that the cable assemblies may be arranged so that all of the currents from some or all of the solar panels in the installation are brought together through a series of junctions and or branch structures to a single cable that can be applied to the terminal of the inverter without need for a combiner box. For example, Yamawaki demonstrates this in various illustrated schematic drawings disclosed therein. *See* EX1006, FIGS. 2-7.

[335] An illustration of an example solar power system from the Amphenol brochure is reproduced below, with annotations, showing the arrangement of solar panels, wire harnesses, and lead assemblies that gather the electrical power from the solar panels and delivers the electrical power to a combiner box.



EX1007, p. 5, middle image (1st-annotation)



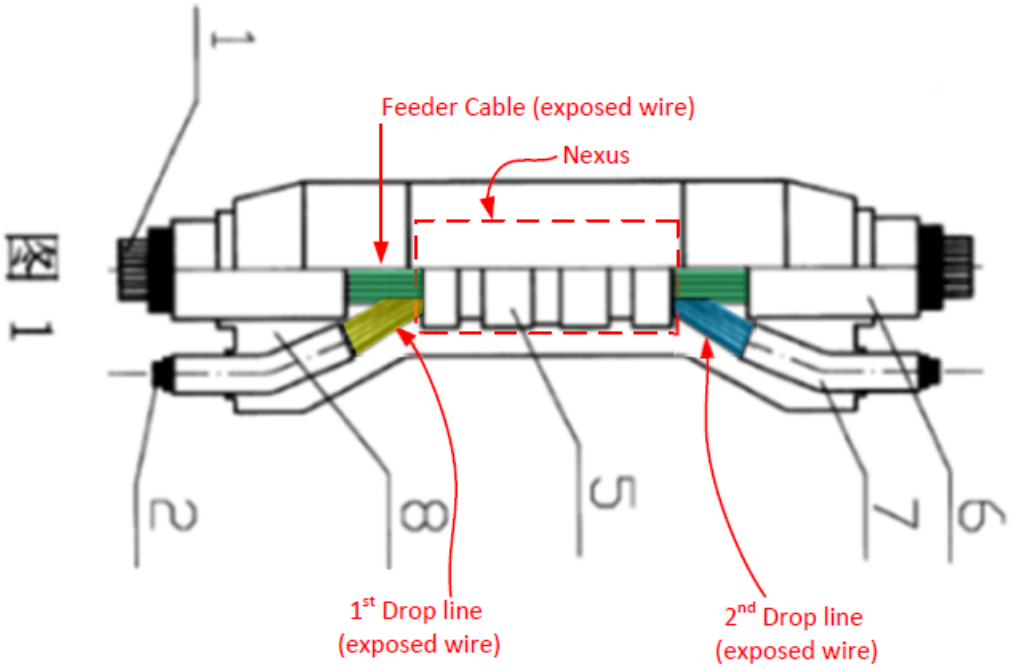
EX1007, p. 13, bottom image (1st-annotation)

[336] Also, as illustrated above, Amphenol provides examples of a variety of junction cable assembly elements that a POSITA would understand can be selected to match the design of a solar array installation. These assemblies include wires, insulation, and molded housings at the junctions that provide protection from corrosion or failure in the field during use. *See id.*, p. 13, bottom image (1st-annotation).

[337] Shao is Chinese patent CN 2785100, published May 31, 2006. *See* EX1008, cover page. This patent relates to a power cables with bidirectional K-shaped branches for power distribution. *See id*., Abstract. Shao particularly discloses a K-shaped branch connector structure that:

> A K-shaped branch structure can enable single-branch-joint double-branch power distribution. The branch lines are led out in an upper direction and a lower direction of the branch joint, respectively and can be led to two floor power distribution boxes, respectively. The branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear.

See EX1008, Abstract and FIG. 1 (1st annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

[338] Shao describes details of construction of a k-branch connector which combines a bi-directional feeder cable with a pair of branch cables to provide an element of a cable harness for use in power distribution. *See* EX1008, Abstract. "A K-shaped branch connector outer sheath 8 is made of an injection molding material of injection molding grade, and a trunk outer sheath 6 and branch-line outer sheaths 7 are made of polyvinyl chloride, polyethylene or low-smoke zero-halogen polyolefin, ensuring that the connector outer sheath and the cable outer sheath are similar in the terms of material and are tightly combined," *Id.*, 6:24-30. "The bidirectionally led branch lines are a whole cable, so that the workload of peeling the cable during production can be decreased, the branch connection reliability of the branch lines can also be improved, and the service

life of the branch joint can be prolonged." *Id*., 5:31-34.

[339] Tamura is generally directed to cable assemblies that provide "high waterproofing performance by virtue of a double waterproof effect." EX1009, ¶17. The disclosure of Tamura is in the same field of electrical connectors as Amphenol and Shao, and is thus analogous prior art, and discloses a "Cable branch molding method." *See id*., ¶3. Tamura also discloses a double-molded structure that provides improved protection from water. *See id*., ¶17.

[340] Key elements in Amphenol, Shao, Tamura and all the other prior art references cited herein, relate to the fact that cable junctions are used to manage the gathering and/or distribution of power, particularly where a larger-diameter cable is joined to one or more smaller diameter cables. More importantly, a POSITA would understand that the benefits of design elements and materials choices for any of these cable junctions are likely to apply to all of these junctions, as all of these elements are concerned with electrical system installations which rely on intersections between cables carrying small currents and large currents, used in situations that benefit from reliability, resistance to environmental factors, simplicity in installation and maintenance and low cost.

[341] As discussed above, the fundamental requirements for cable junctions to be used for combining current in a solar array cable harness and for distributing current in a power distribution cable harness are the same, and that elements of

the design of the K-shaped branch connector in Shao could be considered by a POSITA interested in improvements to the cable junctions disclosed by Amphenol.

[342] A POSITA would understand that the solar power system connectors disclosed by Amphenol could be designed and manufactured using the materials, design, and processes disclosed by Shao and Tamura. For example, the details associated with overlapping and crimping the cable and drop lines using an extended copper C-shaped clamp within the assembly of Shao, which ensures electrical contact (i.e., conductivity) and structural joining of the feeder cable to the drop lines, would have been appreciated as an advantageous approach for the construction of solar power system elements disclosed by Amphenol. Additionally, Shao discloses using insulation layers and injection molding to form the packaging around the nexus of the cables, which would provide protection from external environmental factors such as would be important for the installation of solar power system components of Amphenol. The wire assembly designs disclosed by Amphenol (*see* Figures on pages 5 and 21 from Amphenol, above) would obviously benefit from the features disclosed by Shao, as related to the design and manufacture of the K-shaped branch structure shown in FIG. 1 from Shao, which provide "good insulation performance, heat resistance stability and overheating aging performance." *Id.*,

6:40-7:1. Accordingly, Shao is analogous prior-art to the '153 Patent since Shao is directed to similar problems (sealing wire junctions) in the same field of endeavor (junctions in power wiring) as the '153 Patent.

[343] Although the K-shaped connector disclosed in Shao is described in the context of building construction, a POSITA in the field of solar power systems would consider a wide range of electrical connector designs that can withstand environmental conditions, like extreme moisture, as well as resist tension loads from forces (e.g., wind) acting on cables, which is what is needed for solar installations. *See id.*, 5:25-27. The extended copper C-shaped clamp (5) in Shao's K-shaped connector provides both an electrical and mechanical joint, resulting in a robust physical connection of the drop lines to the main that can prevent droplines from being pulled out of the connector under tension loads. Shao also emphasizes the importance of connection reliability, as well as moisture and water proofing that would also be important for the solar power installations of Amphenol. *See id.*, 5:37-40. A POSITA would consider the use of details provided by Shao to form the branch elements in the broader variety of cable assemblies disclosed by Amphenol in order to capture the features and benefits of the Shao junctions throughout the harnesses of Amphenol. In particular, the details in Shao associated with overlapping and crimping the cable and drop lines within the assembly and using insulation layers and

injection molding to form the packaging around the nexus of the cables would be understood to provide a concise installation with increased service life. *See id.*, 6:18-30.

[344] Stated more directly, Amphenol discloses solar power system components that are obviously intended for use in outdoor settings, because outdoors is where the sunlight is available for capture and conversion to energy. Installations such as those disclosed in Amphenol are obviously intended for reliable capture and conversion of sunlight for years of use because reliable operation, over extended periods, is required because years of use are needed to create enough economic benefit to overcome the cost of the initial installation. A POSITA tasked with designing or assembling wiring components of a solar power installation would be interested in any disclosures that could provide improvements in reliability, flexibility, structural integrity, and cost of the components of the installation. Specifically, a POSITA would appreciate that the cables, connectors, and junctions disclosed in Amphenol can be improved by incorporation of details from a reference such as Shao, as the basic characteristics of cable junctions in Amphenol and Shao are the same, even though Amphenol is intended for solar power combining applications and Shao is intended for more general electrical power distribution applications. Specifically, the detailed description of overlapping and crimping cables, and

the formation of insulation and protection by injection molding from the power distribution K-shaped branch connector of Shao would be understood by a POSITA to provide a more robust connection with the benefits of improved reliability and simplicity if used for the assembly of at least some of the cable junctions of Amphenol for solar power combining applications.

[345] Additionally, a POSITA would consider replacement or addition of the connectors in the wire assembly of Amphenol with the K-shaped branch connectors disclosed by Shao for providing additional branches at each junction while minimizing connectors needed to do so, and for addressing the reliability and performance benefits disclosed in the abstract of Shao, including:

> The branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear. The bidirectionally led branch lines are a whole cable, so that the workload of peeling the cable during production can be decreased, the branch connection reliability of the branch lines can also be improved, the service life of the branch joint can be prolonged, and the power cable has a very good popularization and application value.

EX1008, Abstract.

[346] Also, a POSITA would have an expectation of success in combining Amphenol, Shao, and Tamura since Shao and Tamura complement the disclosure of Amphenol by disclosing design, manufacturing methods, and materials that are appropriate choices for these junctions while also providing alternative connector configurations and advantages thereof. A POSITA that

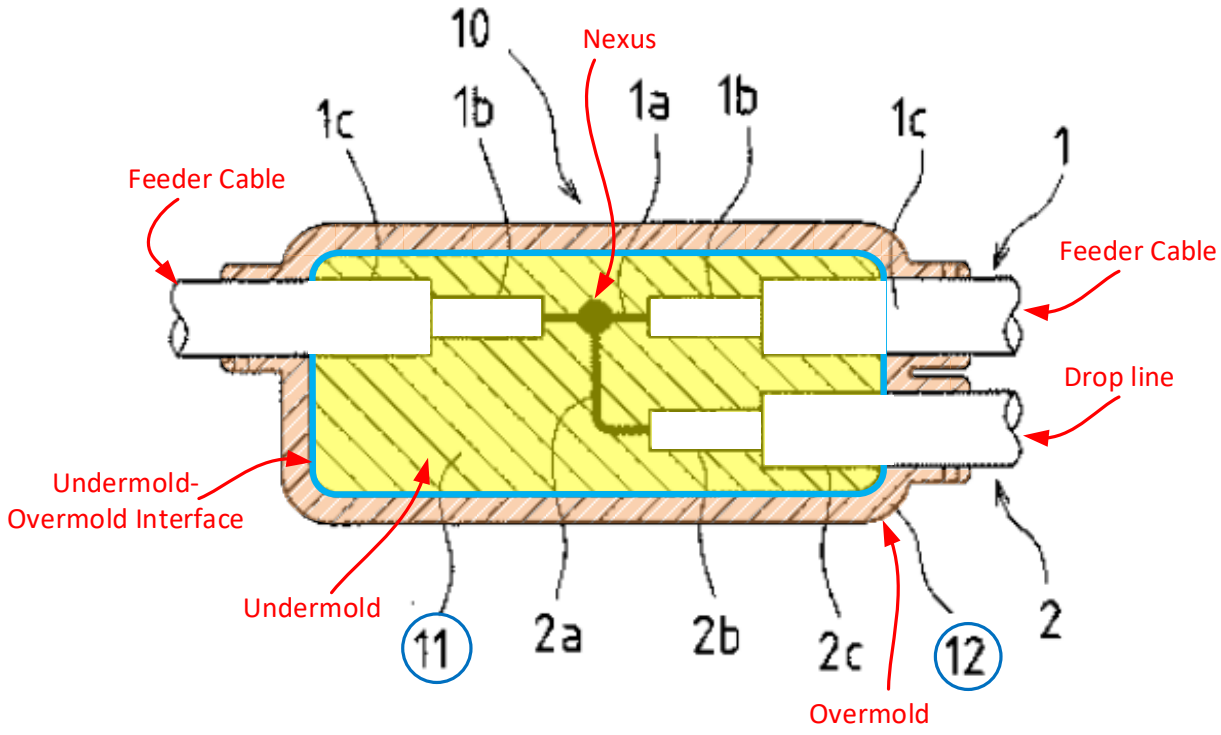
selects components for a solar energy installation and performs the installation would be familiar with the families of components, wire harnesses and lead assemblies disclosed in Amphenol, and would appreciate the benefits of the details provided by Shao and Tamura in design and manufacturing of reliable and easily utilized branch structures. Further, the branch connectors disclosed by Shao and Tamura could be spliced into cables and wire harnesses of Amphenol using the assembly processes taught in Shao, the molding process disclosed by Tamura, as well as ordinary electrical practices.

[347] For these reasons, a POSITA would be motivated to combine the teachings of Amphenol and Shao because the wire harnesses, lead assemblies and solar photovoltaic power generation systems disclosed by Amphenol are intended for use in a harsh outdoor environment and would benefit from added protection from the elements and improved reliability for the branch structures provided by the more robust design and manufacturing processes for the connectors disclosed in Shao.

[348] Amphenol discloses a variety of cable junction geometries allowing users to select combinations for wire harnesses and cable assemblies that are appropriate for their system configuration. Shao discloses a robust connection arrangement that can be used for joining the main cables and drop lines and providing insulation and molding to protect the junctions. Further, a POSITA would have

been motivated to use these detailed junction designs, processes, and materials of Shao to build the entire catalog of wiring harness components disclosed by Amphenol.

[349] Tamura, like Shao, relates to the field of connectors for power cables and more specifically the molding of the branch junctions used for power distribution. EX1009, ¶3. Amphenol, Shao, and Tamura are analogous prior-art to the '153 Patent because they are directed to wiring assemblies like those claimed in the '153 Patent. Therefore, a POSITA charged with designing or fabricating a solar power system and solving the problems addressed in the '153 Patent, would be aware of and motivated to consider Amphenol, Shao, and Tamura.



EX1009, FIG. 1 (1st-annotation)

[350] A POSITA would have been motivated to enhance the wiring assembly taught by Amphenol, as modified by Shao, as taught by Tamura for multiple reasons. First, Tamura discloses using an injection-molded outer mold over an inner mold. EX1009, ¶23. Second, Tamura teaches that better adhesion is achieved by an injection molded PVC outermold over a polyethylene (PE) undermold, which provides better waterproofing. See EX1009, ¶9, above.

[351] Amphenol, Shao, and Tamura are not cumulative references because Amphenol focuses on cable assemblies, connectors, tools, and accessories, Shao addresses the details of the cable junctions, and Tamura teaches the further benefits of applying the overmolding using injection molding for high water proofing performance. *See* EX1007, p.2; EX1008, 4:35-37; EX1009, ¶23.

[352] A POSITA would have an expectation of success in making the Amphenol-Shao-Tamura combination as Tamura provides easy to follow instructions for adding an additional protection layer in the form of an outermold that would be applied to (i.e., simply formed over) the connection joints (nexus) of Amphenol or included in the wiring assembly according to Shao.

[353] A POSITA would have been motivated to modify the connection joints (i.e., nexus) by providing an overmold as taught in Tamura to provide a further layer of structure and protection against environmental affects, particularly moisture,

as well as against abrasion as could be caused by the connection joints rubbing against structures due to wind acting on cables of the many years of service expected for solar power installations.

[354] Although Amphenol, Shao and Tamura do not explicitly refer to the cables and wiring assemblies as "drop lines," "a feeder cable," "lead assembly," "a wire harness," or "a central trunk," as discussed above, a POSITA would understand that the disclosed cables and wiring assemblies are equivalent and/or analogous to drop lines, a feeder cable, a lead assembly, a wire harness, and/or a central trunk. *See* 'C(i) Motivation to Combine Amphenol and Shao,' discussed above.

[355] I am informed by Counsel that as of the earliest priority date of the '153 Patent, a POSITA would have understood or been able to look up the basics of solar array system design, alternative configurations and construction through many well-known references, including the PSE textbook Photovoltaic Systems Engineering EX1011 and the NEC2002 code EX1010 I have referenced herein, as well as U.S. patents, including 6,268,559 (Yamawaki), and published patent applications, including Japanese Patent Application KOKAI Publication No. 7-131045 (EX1019 – "Ito") disclosed in Yamawaki, and U.S. Patent Publication No. 2011/0209741 (Solon741), which I addressed in Ground 1.

[356] So informed about solar power technologies and alternative configurations, a

POSITA would appreciate that it is expensive and complicated to route individual wires from each solar panel all the way to the final terminal of the inverter, and that wire harnesses provide a practical and obvious way to combine the current from a collection of panels, and that cable assemblies provide a practical and obvious way to combine the current from a collection of wire harnesses for delivery to a final terminal of the inverter or combiner box. Therefore, a POSITA would have looked to sources of wiring harnesses, cables, and connectors, such as Amphenol, for the components to assemble solar power systems in an economical yet reliable configurations. Based on the disclosures in solar power component supplier catalogs, such as Amphenol, as well as wiring configuration examples in publications such as Solon741 and Yamawaki, a POSITA would understand that cables, wire harnesses and connectors can be selected and connected in a wide variety of configurations to conduct current from solar panels to inverters in a cost-effective and safe and reliable manner. For example, as discussed in section '*Motivation to Combine Solon741 and Yamawaki*' and shown in the reproduced figures, the NEC2002 teaches a variety of wiring configurations, including wiring harnesses and cabling leading directly to an inverter (*see* e.g., EX1010, Figure 690.1(B)). The Yamawaki patent includes further configuration examples in its figures that a POSITA could consult in selecting a suitable power wiring configuration for a

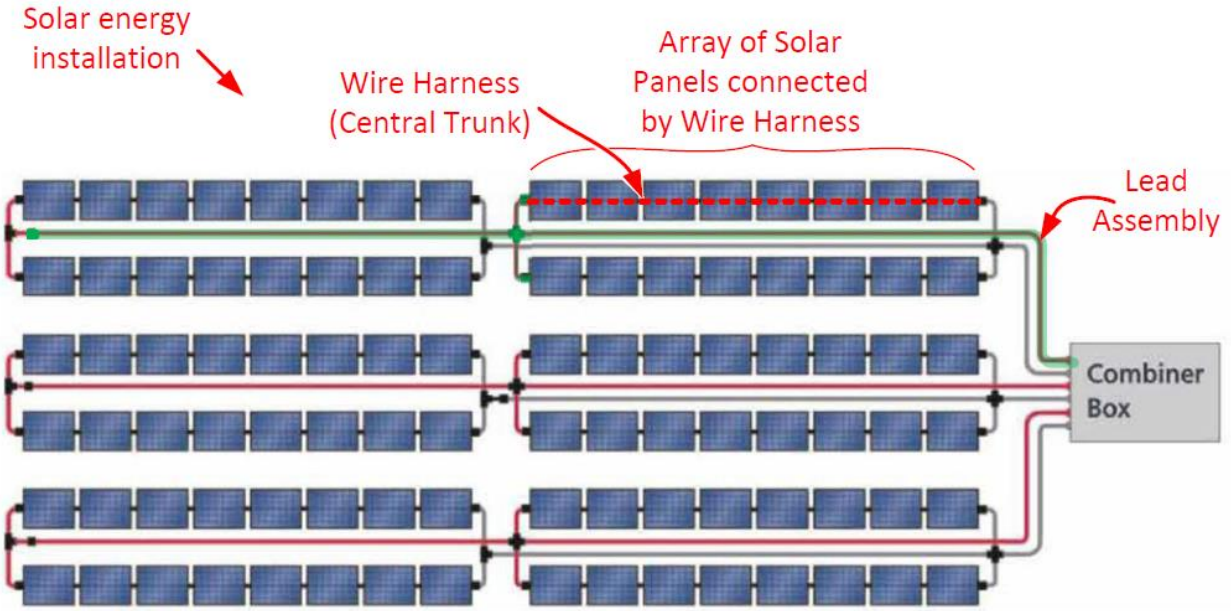
given solar power installation. *See* e.g., EX1006, FIGS. 3-6 and 13. Similarly, Ito figures would inform a POSITA of further wiring configurations for solar panels that include multiple drop lines attached to a main line. See EX1019, FIGS. 1 and 3. Finally, as explained above (e.g., in Ground 1), a POSITA would also know how to use the NEC 2002 to select sizes of cables, connectors and wire harnesses appropriate for each portion of the wiring assembly of such systems. Thus, a POSITA would have the knowledge and engineering tools to assemble the tool kit of cables, connectors, and wire harness components offered for sale in the Amphenol catalog into a suitable assembly of trunk lines, wire harnesses and drop lines with inline fuses to route power from a plurality of solar panels to inverters for a particular solar power installation. For these reasons, it is my opinion that a POSITA would have found the claims addressed in this Ground 4 to be obvious based on the disclosures in Amphenol, Shao, and Tamura as explained below.

1. Claim 1

Preamble. A lead assembly for use in a solar energy installation including:

[357] As discussed above regarding Ground 2, a POSITA would have found the limitations in claim 1(Preamble) to be obvious in view of Amphenol. *See* EX1007, p. 5, middle image (1st-annotation), reproduced below. Also, as discussed above (*see* 'D(i) Motivation to combine Amphenol, Shao, Yamawaki,

and Tamura'), Tamura also discloses this limitation.

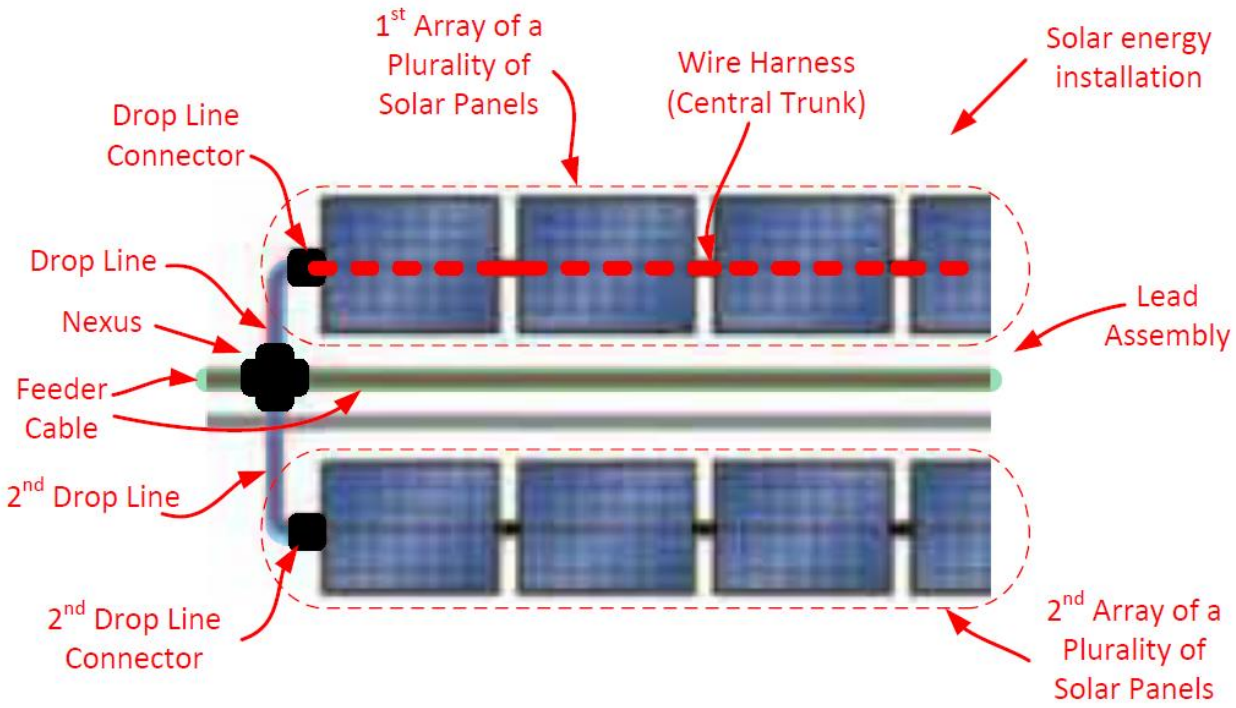


EX1007, p. 5, middle image (1st-annotation)

[358] For these reasons, a POSITA would have found the limitations in claim 1(Preamble) to be obvious based on Amphenol.

a. a drop line terminating at a drop line connector, the drop line connector configured to connect with a central trunk of a wire harness, the central trunk of the wire harness having a plurality of branches that each are configured to electrically connect to a separate solar panel contained in an array of a plurality solar panels;

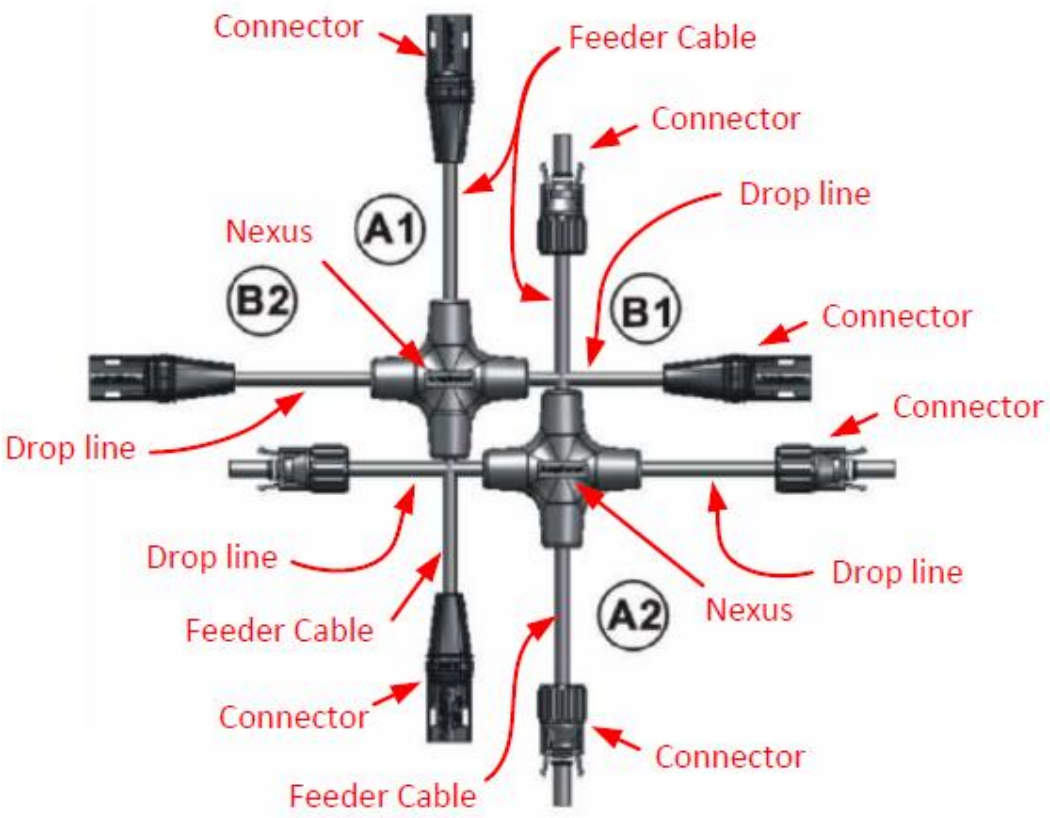
[359] As discussed above regarding Ground 2, Amphenol discloses, and shows in an illustration reproduced below, two drop lines (annotated in blue) off a feeder cable (annotated in green) of the lead assembly, where each drop line terminates in a drop line connector. *See* EX1007, p. 5, middle image (Relief & 2nd annotation), reproduced below.



EX1007, p. 5, middle image (Relief & 2nd-annotation)

[360] Additionally, as shown in the image above, Amphenol discloses that the drop line connector is connected to a central trunk of a wire harness (annotated as a red dotted line), and the central trunk of the wire harness inherently has a plurality of branches that each electrically connect to separate solar panels that together are a part of an array of a plurality of solar panels. *See id.*, above.

[361] Further, Amphenol discloses a wide variety of cable configurations, joining assemblies, wire harnesses, and connectors that a POSITA would know how to connect together based on the teachings in Amphenol to form a wide array of wiring configurations, including connecting panels in series (as shown above) and parallel, such as using wiring harness components such as illustrated below.



EX1007, p. 13, bottom image (1st-annotation)

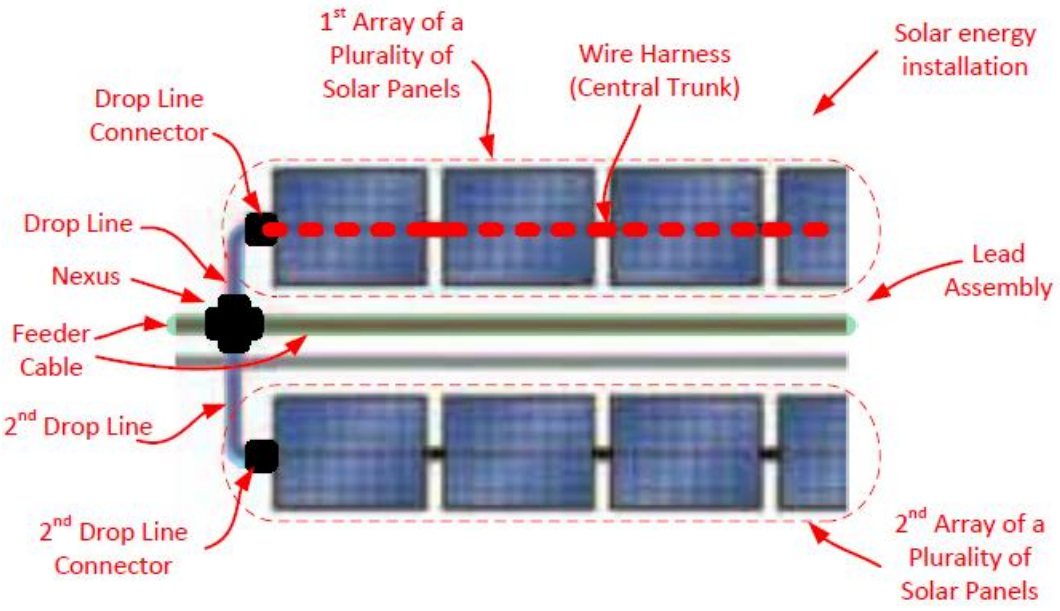
[362] Although Amphenol does not explicitly refer to the cables and wiring assemblies labeled in the annotation above as "drop lines," "a feeder cable," "lead assembly," "a wire harness," or "a central trunk," as discussed above a POSITA would understand that the disclosed cables and wiring assemblies are equivalent and/or analogous to drop lines, a feeder cable, a lead assembly, a wire harness, and/or a central trunk. *See* 'C(i) Motivation to Combine Amphenol and Shao,' discussed above.

[363] Therefore, in view of the full disclosure of solar component cables, connectors and wiring harness components disclosed in Amphenol, a POSITA

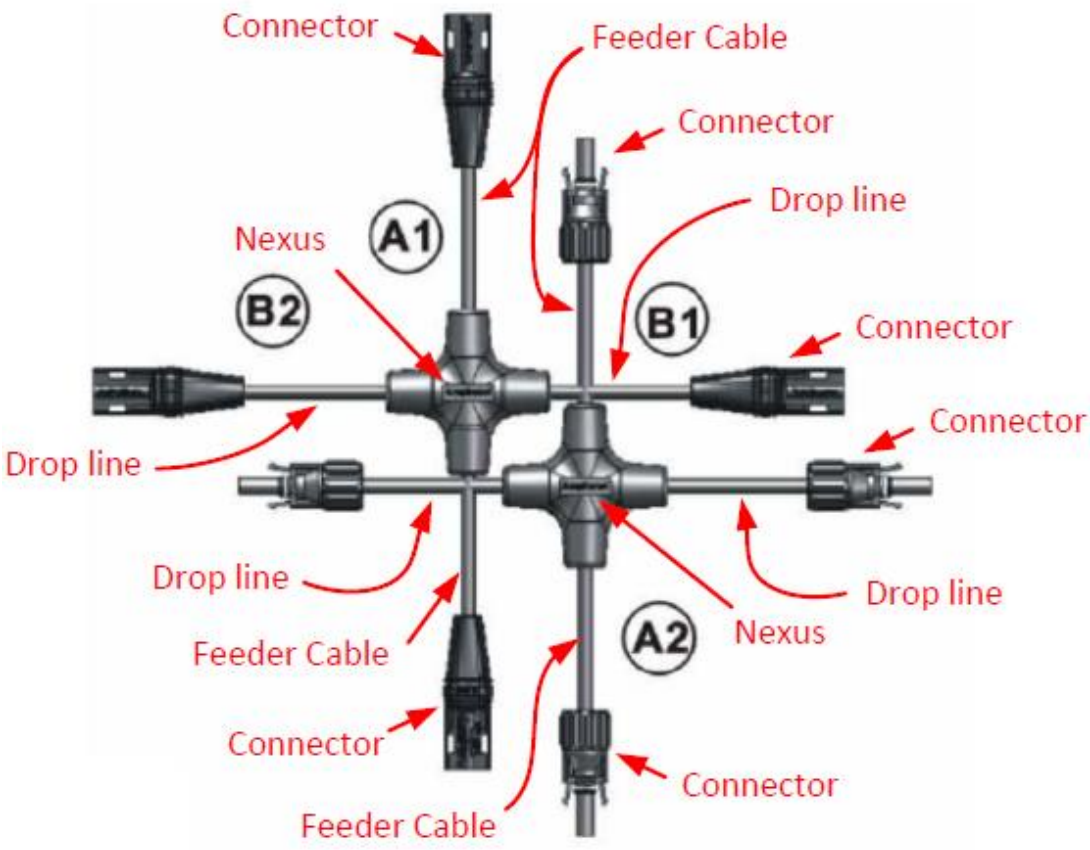
would have found the limitations in claim 1(a) to be obvious based on Amphenol.

b. a feeder cable electrically coupled to the drop line at a nexus;

[364] As discussed above regarding Ground 2, Amphenol discloses, and shows in images reproduced below, a feeder cable (i.e., a "main cable") electrically coupled to the drop line (i.e., a "branch cable") at a nexus. *See* EX1007, p. 5, middle image (Relief & 2nd-annotation) and p. 13, bottom image (1st-annotation), reproduced below.



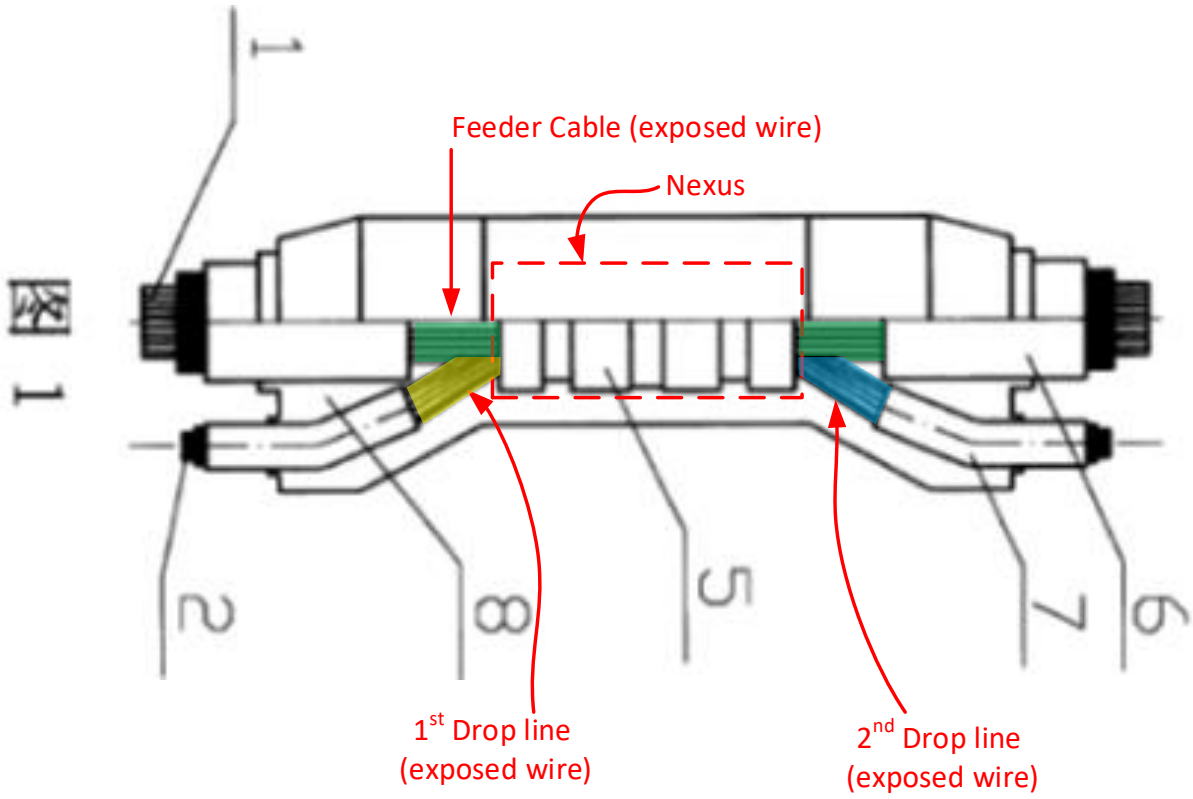
EX1007, p. 5, middle image (Relief & 2nd-annotation)



EX1007, p. 13, bottom image (1st-annotation)

[365] Amphenol, on p. 21, discloses and illustrates in images various junction cable assembly configurations, referring to the feeder cable as a "main cable" (labeled "A1" and "A2" in the bottom image on p. 21, shown above) and each of the drop lines as a "branch cable" (labeled "B1" and "B2" in the bottom image on p. 21, shown above). *See* EX1007, p. 13. While Amphenol inherently discloses the electrical coupling of the feeder cable and the drop line at a nexus, Amphenol does not illustrate the actual electrical coupling between the feeder cable and drop line that is inside the illustrated molded junction. Shao discloses details of the feeder cable's electrical coupling to the drop line at

the nexus, along with details associated with the encapsulation of the junction to provide protection from the external environment. Shao, which is in the related field of electrical connectors, discloses a feeder cable electrically coupled to the drop line at a nexus that includes a clamp holding the feeder cable in contact with the drop line. *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

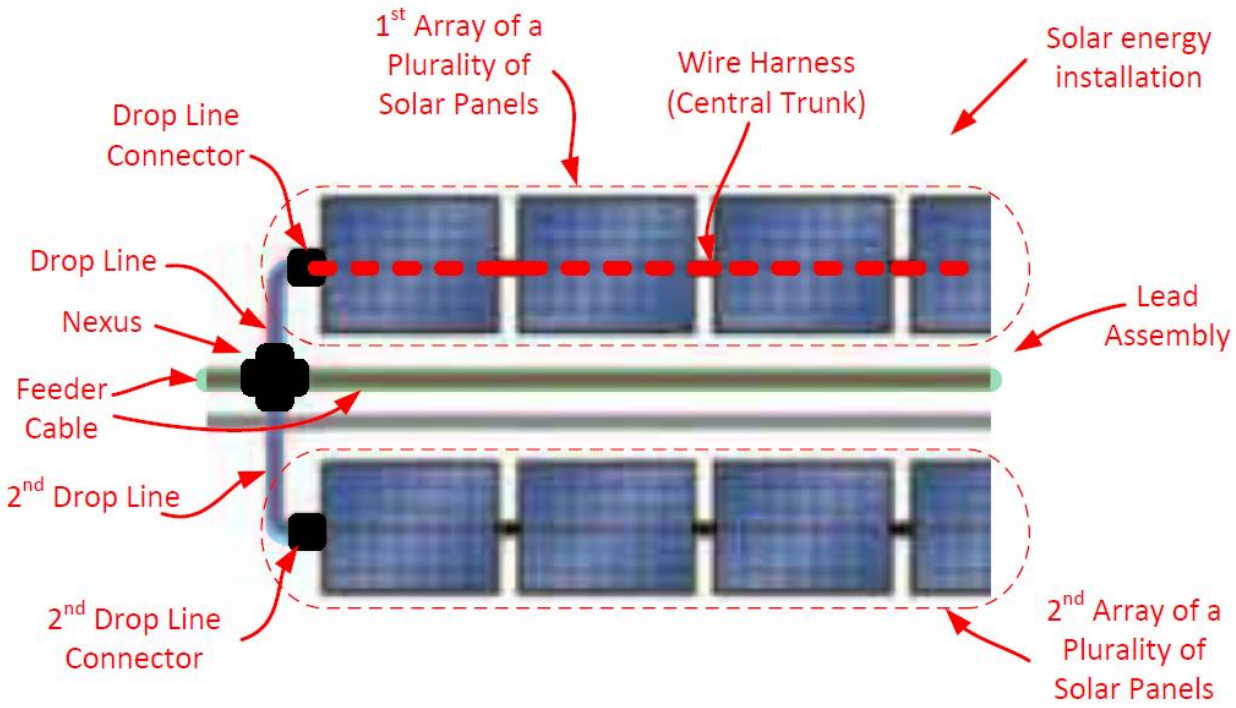
[366] As illustrated, Shao discloses a nexus configuration with a clamp, as taught by Shao, to ensure contact and good conductivity is maintained between the two conductive elements. A POSITA would have been motivated to include junction connections as taught by Shao within wiring assemblies using

Amphenol cables and wiring harnesses in locations requiring more robust connections of drop lines to provide greater protection from moisture penetration and disassembly for tension loads on the cables. (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed above).

[367] For these reasons, a POSITA would have found the limitations in claim 1(b) to be obvious based on Amphenol and Shao.

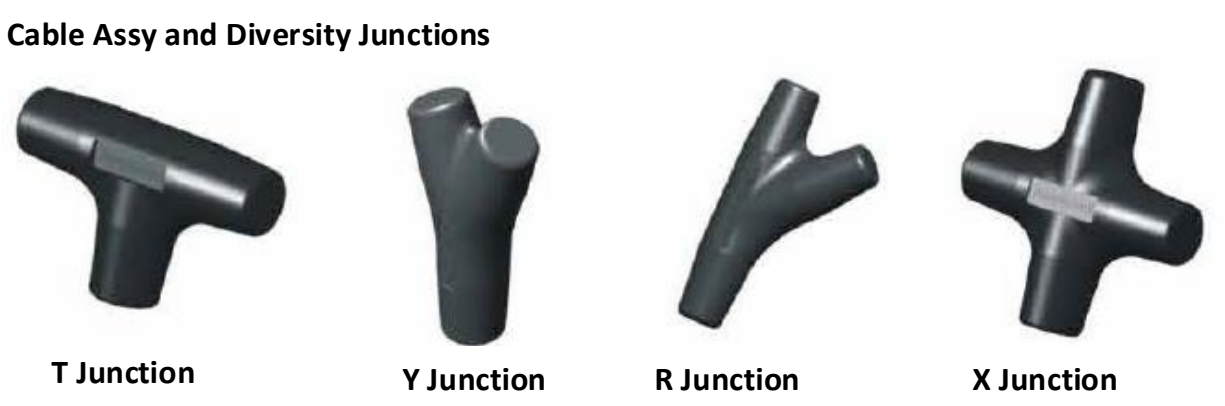
c. an undermold that fully encases the nexus, the undermold further comprising:

[368] The molded junction covering the wiring and union of the various forms of nexus in Amphenol is an undermold that fully encases the nexus since the molded junction covering the nexus may serve as a substrate for an overmold. *See* EX1007, p. 5, middle image (Relief & 2nd-annotation), reproduced below.



EX1007, p. 5, middle image (Relief & 2nd-annotation)

[369] In fact, Amphenol discloses various different types of molded junctions (i.e., primary molds or undermolds) that may be used to enclose a nexus. *See* EX1007, p.5, bottom image, reproduced below. The junction annotated as the "Nexus," above from Amphenol is referred to as an "X Junction" in the 'Cable Assy and Diversity Junctions' figure reproduced below, which is also from Amphenol. *See id*.



EX1007, p. 5, bottom image

[370] Shao discloses a feeder cable's electrical coupling to drop lines at a nexus that is covered by a sheath made of injection molding material, which is an undermold that fully encases the nexus. *See* EX1008, 5: 16-20. The examples of junctions shown on page 5 of Amphenol (T Junction, Y Junction, R Junction, X Junction) are examples of 2-terminal, 3-terminal, and 4-terminal junctions that one would consider for use in lead assemblies. A POSITA would understand that these example junctions, and many more similar examples could be assembled as disclosed in Shao. For example, it would have been obvious to a POSITA to rely on the teaching of Shao to provide the design of the cable junction, including methods for baring wires, providing a clamp, forming a nexus by closing the clamp around the wires, and providing an injection-molded undermold to encase the exposed cables and the metal clamp holding them together and protect those elements from damage and/or exposure (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed

above).

[371] For these reasons, a POSITA would have found the limitations in claim 1(c) to be obvious based on the Amphenol and Shao.

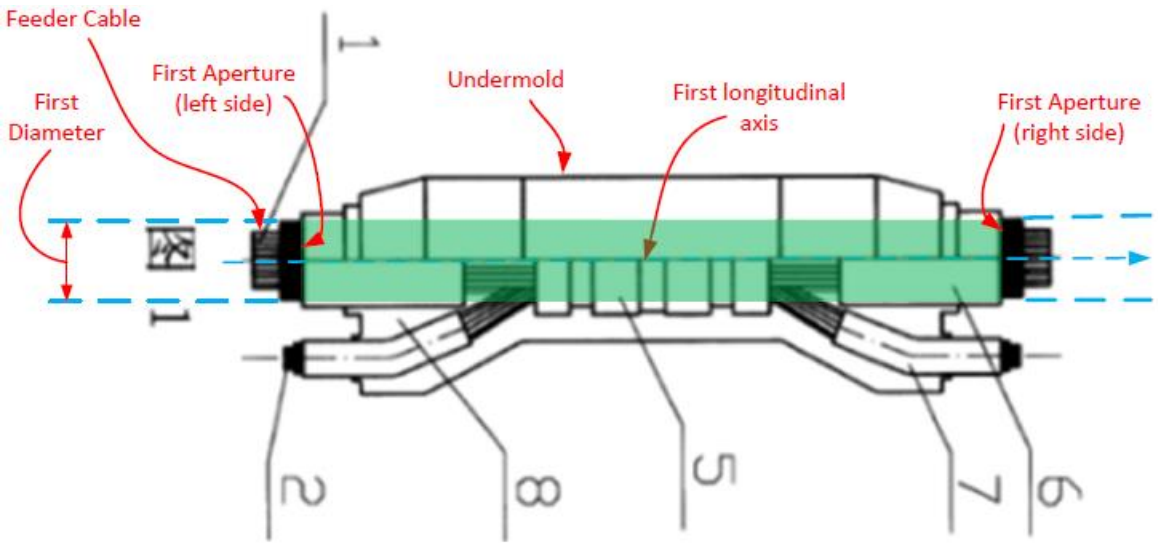
i. a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis; and

[372] As discussed above regarding Ground 2, a POSITA viewing the T, Y, R, and X junctions examples shown in the figures from Amphenol below would understand that the wire passing through the junction will necessarily create a path through the mold material, thus forming a "first aperture" extending through the mold.



EX1007, p. 5, bottom image

[373] Shao discloses a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis. *See* EX1008, FIG. 1 (2nd-annotation), reproduced below.

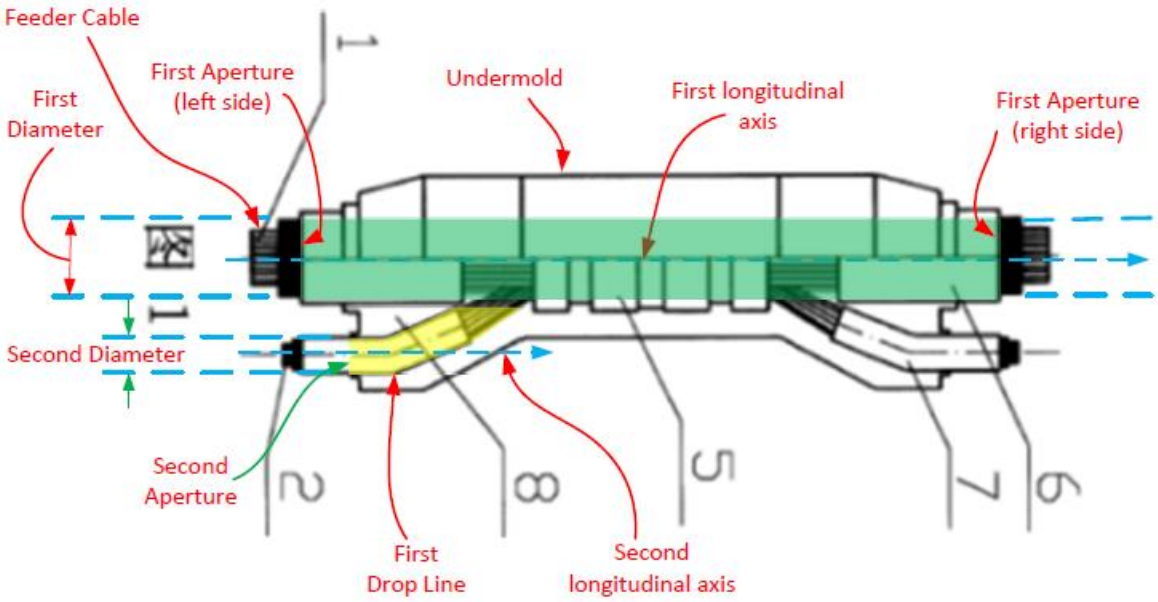


EX1008, FIG. 1 (2nd-annotation)

[374] For these reasons, a POSITA would have found the limitations in claim 1(c)(i) to be obvious based on the Amphenol-Shao combination.

ii. a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis;

[375] As discussed above regarding Ground 2, Shao discloses a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis. *See* EX1008, (3rd-annotation), reproduced below.



EX1008, FIG. 1 (3rd-annotation)

[376] For these reasons, a POSITA would have found the limitations in claim 1(c)(ii) to be obvious based on the Amphenol-Shao combination. Also, as discussed above (*see* 'D(i) Motivation to combine Amphenol, Shao, and Tamura'), Tamura also discloses this limitation.

iii. a third aperture extending partially through the undermold and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis; and

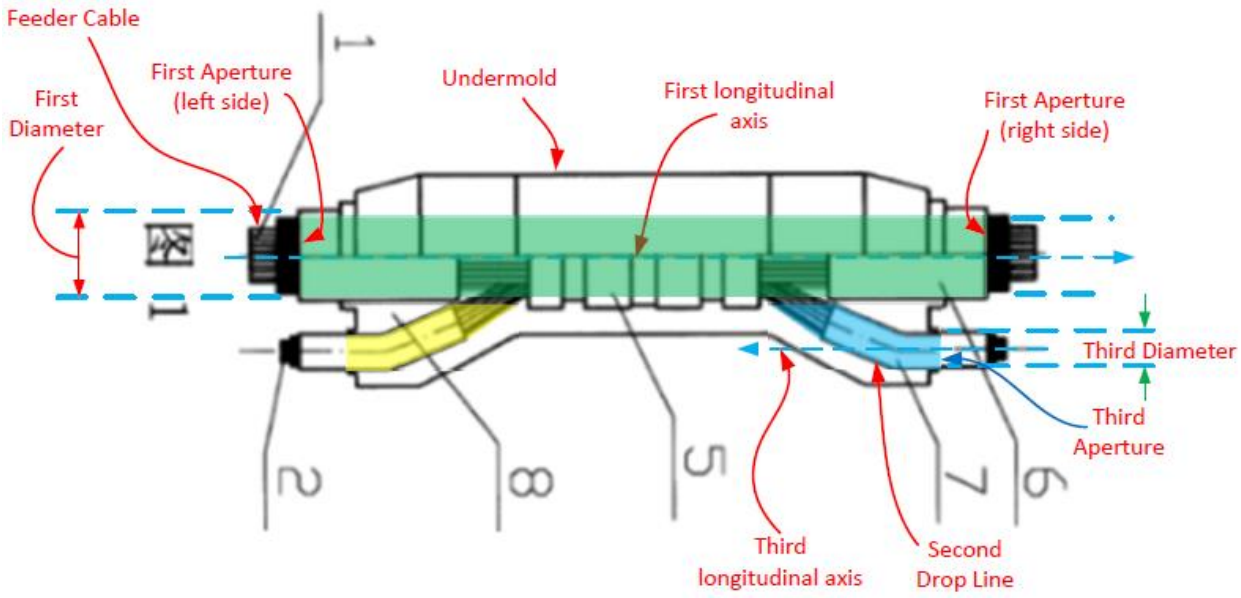
[377] A POSITA viewing the X junction example shown in the figure from Amphenol, below, would understand that the wire or wires being coupled to the main wire in these junctions necessarily creates a second path through the mold material, thus forming a "third aperture" extending partially through the mold. *See* EX1007, p.5, X Junction from bottom image, reproduced below. If the

current carried by the attached wire is less than the main line, which will be the case for drop lines connecting to a main line, a POSITA would know to use smaller diameter cables based on NEC2002 guidelines, and thus the "third aperture" would have a smaller diameter than the first aperture around the main line. Further, the X junction example shows the connecting wire, and thus the third aperture, exiting the junction along a longitudinal axis different from the axis of the main wire. *See id.*



EX1007, p. 5, X Junction from bottom image

[378] Shao discloses a third aperture extending partially through the undermold and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis. *See* EX1008, (4th-annotation), reproduced below.



EX1008, FIG. 1 (4th-annotation)

[379] Shao specifically discloses the connection of "One trunk conductor and two branch-line conductors are symmetrically overlapped and crimped by means of the K-shaped branch connector 5 to form one joint and two branch-line conductor out-leads." *See id*., 6:18-21. Shao discloses a feeder cable (i.e., single trunk conductor 1) and a pair of drop lines (i.e., branch line conductors 2) that are brought together by the crimp (connector 5) to form the junction. *See* EX1008, (4th-annotation), above. This arrangement provides for a first aperture (along the trunk conductor), and a second and third aperture (along the two branch-line conductors).

[380] For these reasons, a POSITA would have found the limitations in claim 1(c)(iii) to be obvious based on Amphenol and Shao

d. an overmold surrounding the undermold and forming an undermold-overmold interface at an outer surface of the undermold.

[381] Tamura teaches applying an overmold over an undermold of a branch cable connection to provide an added layer of waterproofing. As described by Tamura:

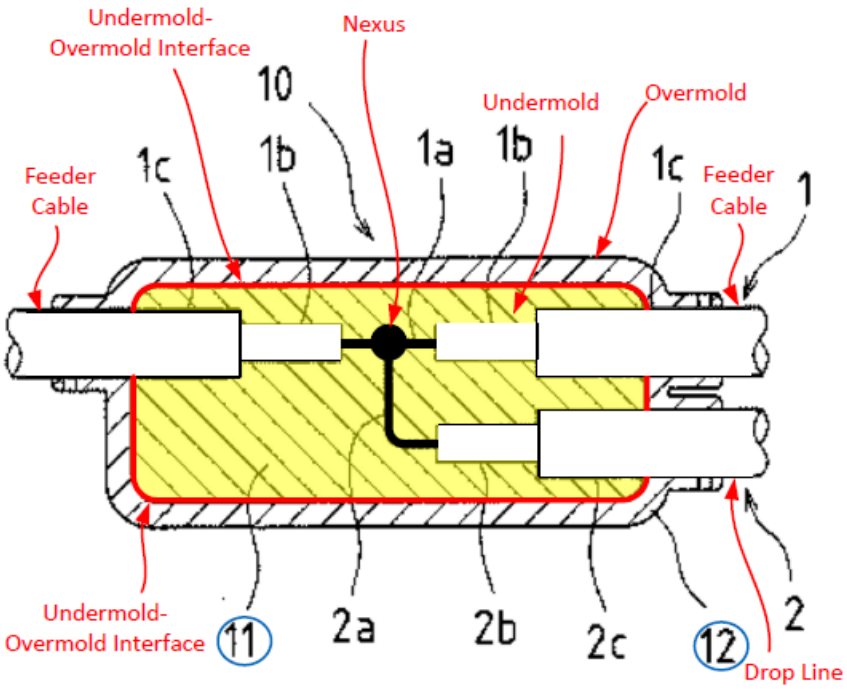
> PE is used for the resin of the inside molded portion 11. The inside molded portion 11 adheres to outer circumferential surfaces of the conductors 1a, 2a of the trunk cable 1 and the branch cable 2, and the 25 insulators 1b, 2b (also including a portion of the sheath materials 1c, 2c) of the cables…PVC is used for the resin of the outside molded portion 30 12. The outside molded portion 12 adheres to the outer circumferential surfaces of the sheath materials 1c, 2c of the trunk cable 1 and the branch cable 2…According to this embodiment, the same resin (PE) as that of the insulators 1b, 2b of the CV cable is thus used as the resin of the inside molded portion 11, which therefore improves adhesion between the inside molded portion 11 and the insulators 1b, 2b. Additionally, the same resin (PVC) as that of the sheath materials 1c, 2c of the CV cable is used as the resin of the outside molded portion, which therefore also improves adhesion between the outside molded portion 12 and the sheath materials 1c, 2c. This makes it possible to achieve greater waterproofing performance by virtue of a double waterproofing effect.

EX1009, ¶¶15-17.

[382] Therefore, a POSITA would have been motivated to modify the nexus designs of Amphenol as modified by Shao to add an overmold according to Tamura in order to achieve greater waterproofing performance by virtue of a double waterproofing effect.

[383] Accordingly, Tamura describes an undermold formed of PV and an overmold formed of PVC, as described above in the excerpt from Tamura

describing Fig. 1, shown below.



EX1009, Fig. 1 (1st-annotation)

[384] A POSITA considering Shao and Tamura would appreciate that these two disclosures describe methods for encasing cable junctions with insulating layers that can provide protection from the environment and other benefits discussed earlier with respect to Shao (*see* 'D(i) Motivation to Combine Amphenol, Shao, and Tamura' further discussed above). A POSITA considering Shao and Tamura would have found it obvious to add an overmold to the Amphenol-Shao combination in order to provide the added protection against environmental elements (e.g., waterproofing), as taught by Shao (*see* 'D(i) Motivation to Combine Amphenol, Shao, and Tamura' further discussed above). For these reasons, a POSITA would have found the claim 1(d) limitations to be obvious

in view of the Amphenol-Shao-Tamura combination.

[385] In addition, to the combination of Amphenol and Shao discussed above, the POSITA would further be motivated to combine the solar power system and connectors as taught by Amphenol and modified by Shao with the multi-layered protective arrangement taught by Tamura in order to provide a compact, layered casing that better protects the solar power system branch connectors against the elements. Further, a POSITA would have an expectation of success in making the Amphenol-Shao-Tamura combination since these references complement one another by further protecting and strengthening solar power system branch connections.

[386] Specifically, Tamura goes on to explain that the double-molding described in this disclosure can be applied broadly, "…the present invention may also be applied to molding of branch portions for various types of cables used for connecting electrical devices such as modules for snow melting purposes and modules for tape heaters." *See id*., ¶25. Thereby, Tamura is explicitly encouraging POSITAs to apply the details disclosed in Tamura broadly, which would motivate and indicate likely success to a POSITA.

[387] Further, a POSITA would have understood to achieve these advantages, the selection of "PVC resins" for several of the layers of the assembly, and the use of an inner mold part and an outer mold part disclosed by Tamura could be

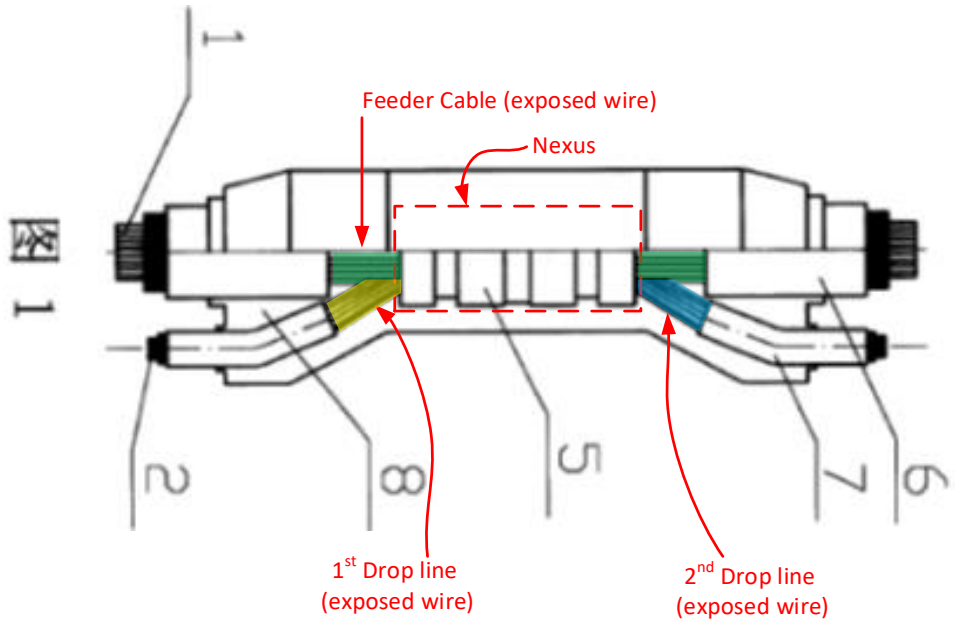
successfully applied to the modified harness of Amphenol-Shao.

[388] A POSITA would have found claim 1 to be obvious based on the Amphenol-Shao-Tamura combination. Accordingly, claim 1 should be found invalid under 35 U.S.C. § 103 based on Amphenol, Shao, and Tamura.

2. Claim 2

The lead assembly of claim 1 wherein the drop line includes a section of exposed wire at the *nexus*.

[389] As discussed above regarding Ground 2, Shao discloses, and shows in an illustration reproduced below, that the drop line (i.e., branch-line conductor 2) includes a section of exposed wire (colored yellow in the annotation below) at the nexus. *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

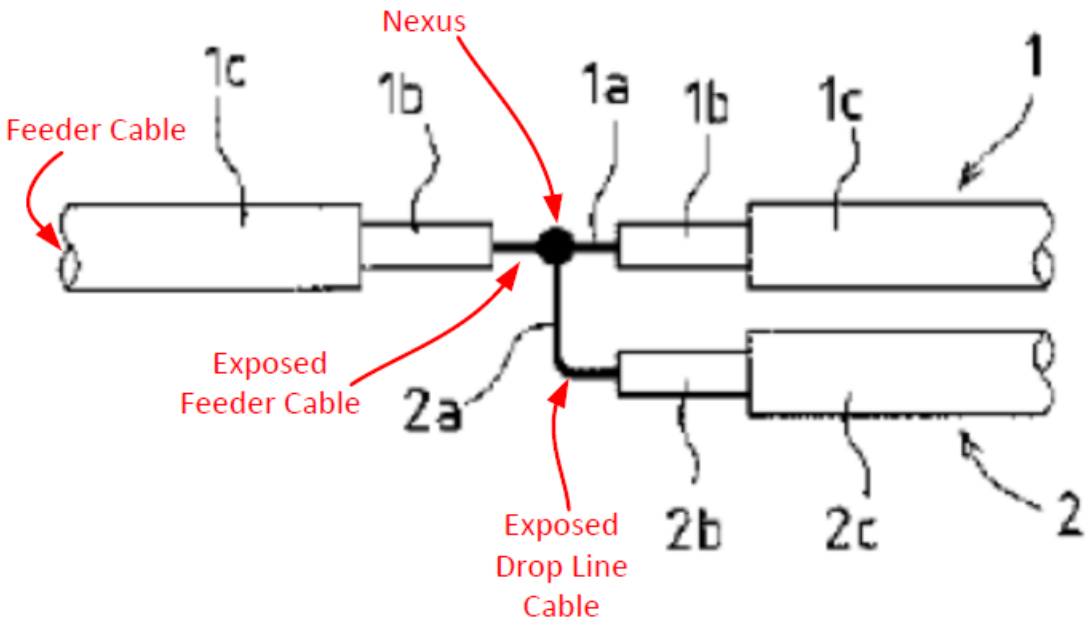
[390] As a general observation, any cable junction that combines multiple cables

must include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables. Therefore, it would be obvious to include a section of exposed wire for the feeder cable and the drop line at the location of the nexus. Nevertheless, Shao discloses the details of the cable junction including the obvious need to remove insulation and provide exposed wire for the feeder cable and the drop lines at the nexus.

[391] Similarly, Tamura discloses that:

> [T]he procedure for branching a CV cable first comprises stripping a sheath material (PVC) 1c and an insulator (PE) 1b of a trunk cable 1 to expose a conductor 1a. A sheath material (PVC) 2c and an insulator (PE) 2b at an end portion of a branch cable 2 are then stripped to expose a conductor 2a, and this conductor 2a is connected to the conductor 1a of the trunk cable 1. It should be noted that, in the example depicted in fig. 5, a portion of the sheath materials 1c, 2c of the trunk cable 1 and the branch cable 2 has been stripped at the branch portion so as to expose a portion of the insulators 1b, 2b.

See id., ¶13 and *see* FIG. 5 (1st-annotation), below.



EX1009, FIG. 5 (1st-annotation)

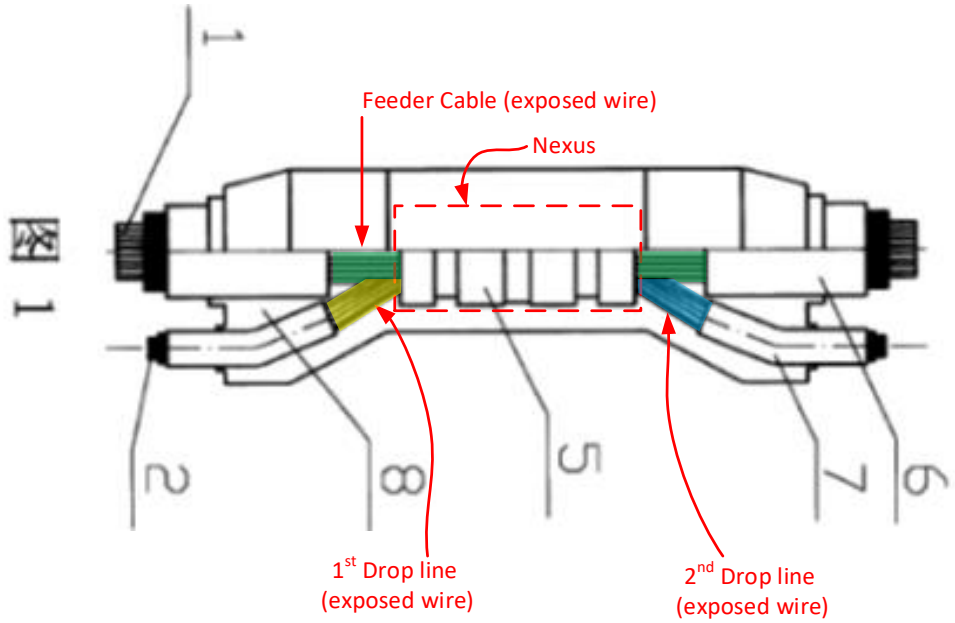
[392] Stripping cables to expose wires at a nexus is the most typical way of joining wires. Therefore, it would be obvious to include a section of exposed wire for the feeder cable and the drop line at the location of the nexus, as explicitly disclosed by Shao.

[393] For these reasons, a POSITA would have found the limitations in claim 2 to be obvious based on the Amphenol-Shao-Tamura combination.

3. Claim 3

The lead assembly of claim 2 wherein the feeder cable includes a section of exposed wire at the *nexus*.

[394] As discussed above regarding Ground 2, Shao discloses, and shows in an illustration reproduced below, that the feeder cable (i.e., trunk conductor 1) includes a section of exposed wire (colored green in the annotation below) at the nexus. *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

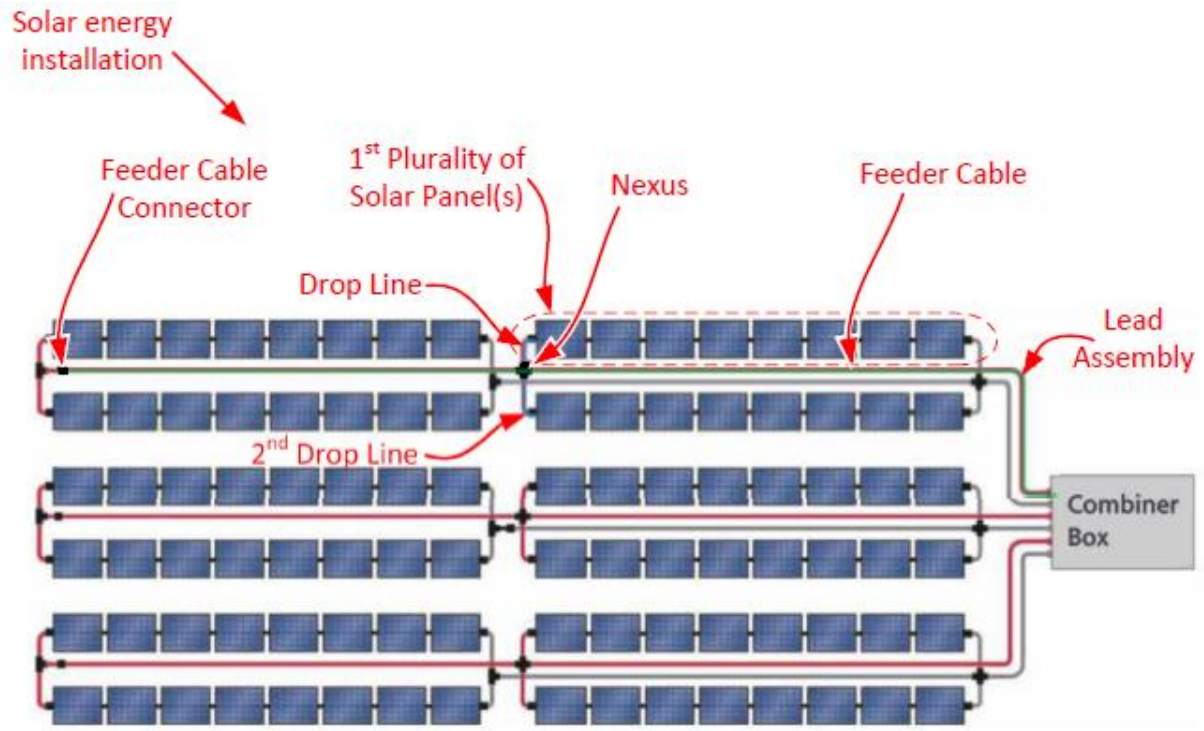
[395] As discussed above, any cable junction that combines multiple cables must include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables.

[396] For these reasons, a POSITA would have found the limitations in claim 3 to be obvious based on the Amphenol-Shao-Tamura combination.

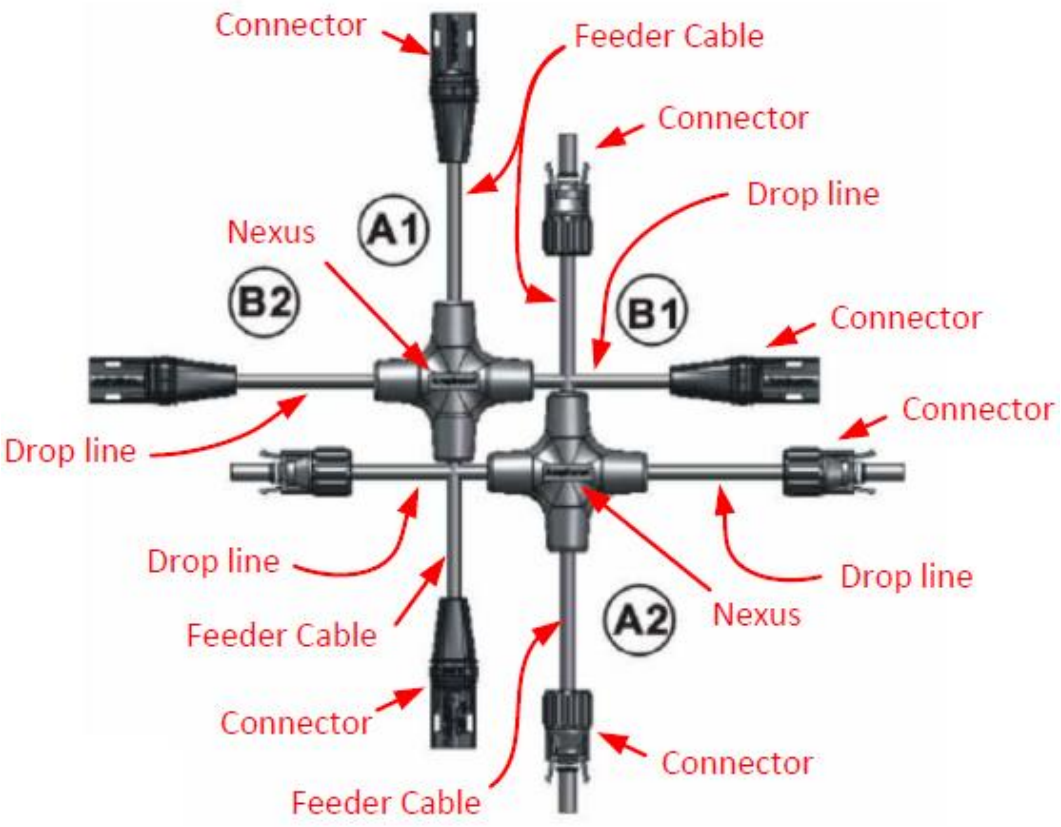
4. Claim 5

The lead assembly of claim 1, wherein the feeder cable terminates at a feeder cable connector.

[397] As discussed above regarding Ground 2, Amphenol discloses, and shows in illustrations reproduced below, that the feeder cable terminates at a feeder cable connector. *See* EX1007, p. 5, middle image (2nd-annotation) and p. 13, bottom image (1st-annotation), reproduced below.



EX1007, p. 5, middle image (2nd-annotation)



EX1007, p. 13, bottom image (1st-annotation)

[398] For these reasons, a POSITA would have found the limitations in claim 5 to be obvious based on the Amphenol-Shao-Tamura combination.

5. Claim 6

[399] I am informed by Counsel that the recitation of "the feeder cable connector is configured to attach directly to an inverter," is an intended use limitation since it recites a feature (i.e., the feeder cable connector) by what it does (i.e., attach directly to an inverter) rather than by what it is. Nonetheless, although Amphenol doesn't disclose the feeder cable connector attached directly to an

inverter, this wiring configuration was well known to POSITAs. *See* EX1010, Fig. 690.1(B)(top diagram), p.544, reproduced below. For example, a POSITA would have been familiar with the NEC 2002 which illustrates in Figure 690.1(B) of a main feeder cable of a branching "photovoltaic source circuit" connected directly to an inverter. *See id*.

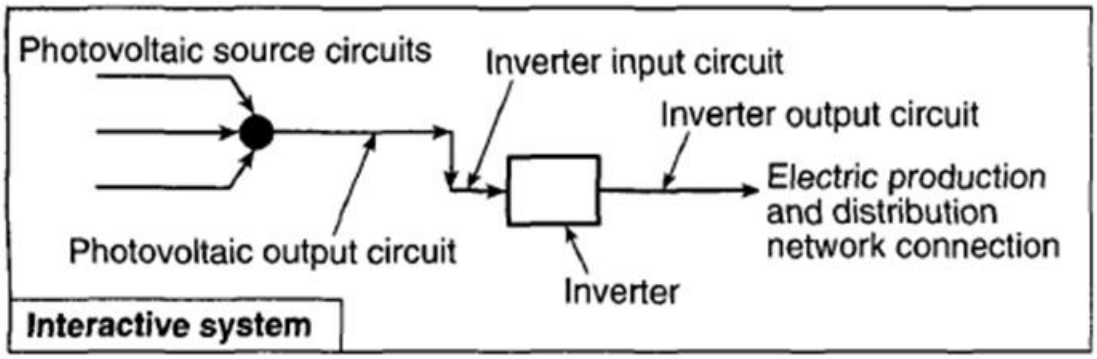


Figure 690.1(B) (top diagram)

[400] Further, a POSITA would have been motivated to attach a feeder cable directly to an inverter, particularly for installations in which the inverter is in close proximity and can extend to be connected directly to feeder cable without the need for a jumper cable.

[401] As discussed above, a POSITA would further understand that the combiner box is one example of a convenient means for merging current from several lead assemblies to a single cable that is applied to the terminal of the inverter. Alternately, a POSITA would understand that the cable assemblies may be arranged so that all of the current from the solar panels in the installation are brought together through a series of junctions and or branch structures to a

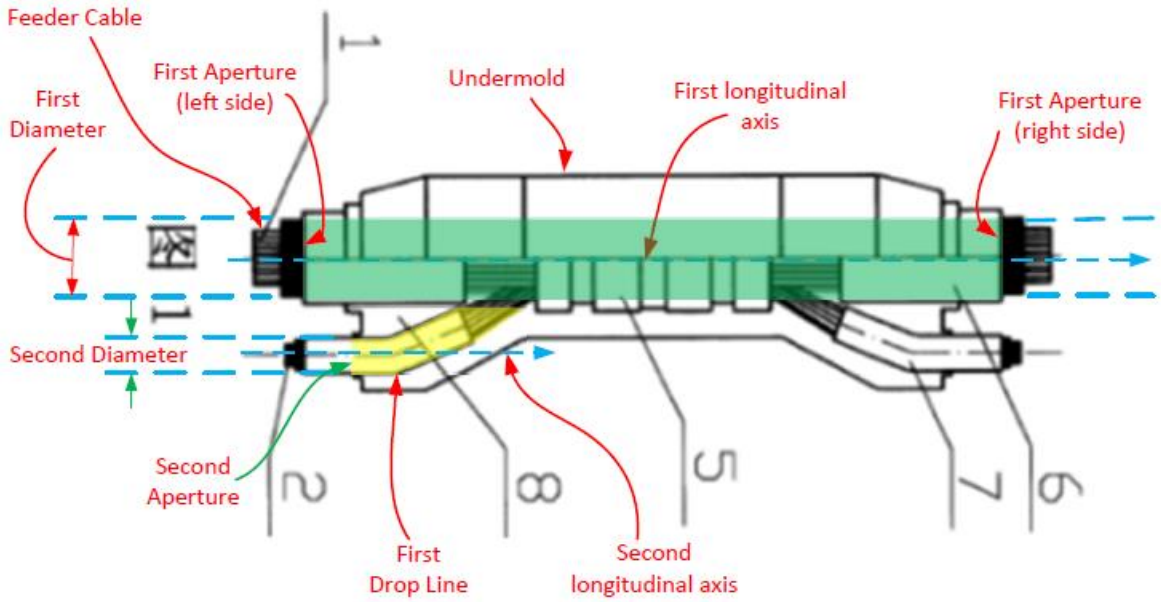
single cable that can be applied to the terminal of the inverter without need for a combiner box.

[402] Therefore, it would have been obvious to a POSITA to attach the feeder cable connector directly to an inverter based on the disclosure of Amphenol and well known design choice. For these reasons, a POSITA would have found the claim 6 limitations to be obvious based on the Amphenol-Shao-Tamura combination.

6. Claim 8

The lead assembly of claim 1, wherein the first longitudinal axis and the second longitudinal axis are substantially parallel.

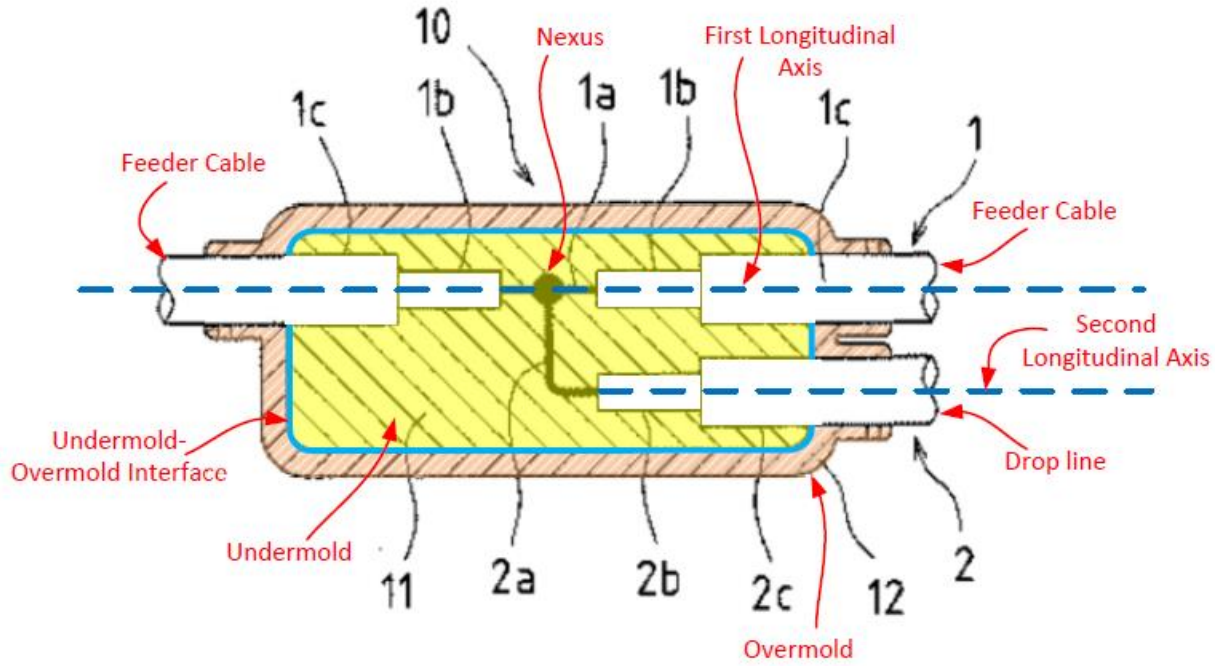
[403] As discussed above regarding Ground 2, Shao discloses, and shows in an illustration reproduced below, that the first longitudinal axis (of the first aperture) and the second longitudinal axis (of the second aperture) are substantially parallel. *See* EX1008, (3rd-annotation), reproduced below. This configuration of substantially parallel axis provides a compact configuration enabling branch wires to divide off from the feeder cable, while maintaining a profile not much wider than the original feeder cable. *See id*.



EX1008, FIG. 1 (3rd-annotation)

[404] For these reasons, a POSITA would have found the limitations in claim 8 to be obvious based on the Amphenol-Shao-Tamura combination.

[405] Similarly, FIG. 1 of Tamura reproduced below discloses that a first longitudinal axis of a first aperture that extends completely through the undermold (i.e., the "inside molded portion 11), through which the feeder cable (i.e., trunk cable 1) extends, is parallel to a second longitudinal axis of a second aperture that extends partially through the undermold, from which the drop line (i.e., branch cable 2) extends. *See id*., FIG. 1 (1st-annotation), reproduced below. This configuration of substantially parallel axis provides a compact configuration enabling branch wires to divide off from the feeder cable, while maintaining a profile not much wider than the original feeder cable.



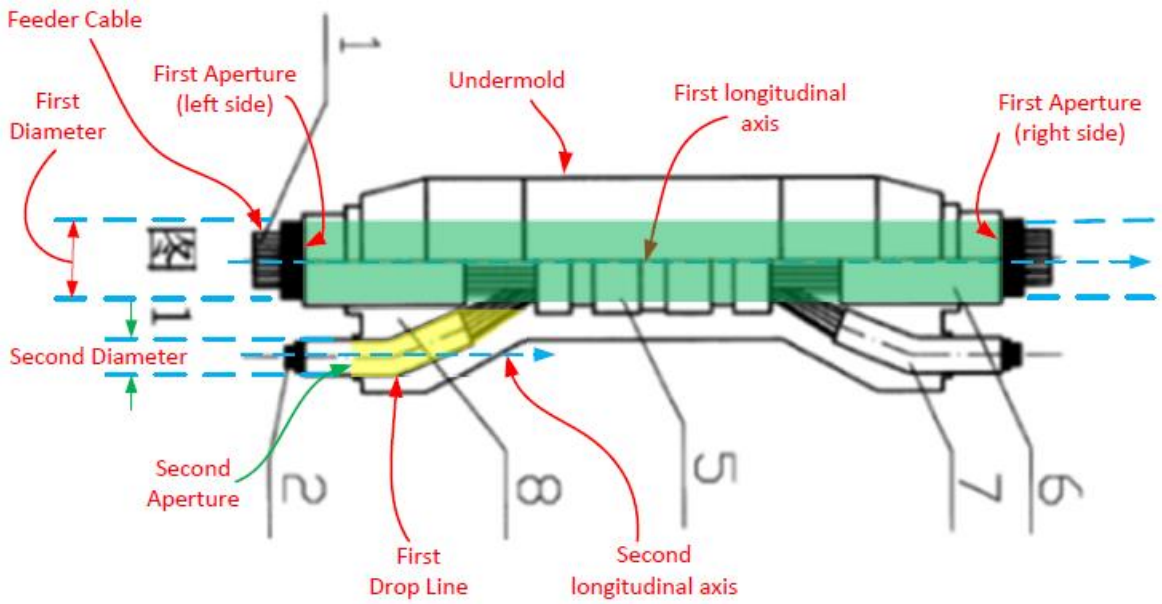
EX1009, FIG. 1 (1st-annotation)

[406] For these reasons, a POSITA would have found the limitations in claim 8 to be obvious based on the Amphenol-Shao-Tamura combination.

7. Claim 9

The lead assembly of claim 1, wherein the second diameter is smaller than the first diameter.

[407] As discussed above regarding Ground 2, Shao discloses, and shows in an illustration reproduced below, that the second diameter (of the second aperture) is smaller than the first diameter (of the first aperture). *See* EX1008, FIG. 1 (3rd-annotation), reproduced below.



EX1008, FIG. 1 (3rd-annotation)

[408] A POSITA would understand that the drop lines bring current from individual solar array elements and merges this current with the other current already flowing from other elements in the feeder cable. Generally, drop lines carry less current than feeder cables, and as a result can be smaller diameter cables that are lighter, easier to manipulate, and less expensive. A POSITA would use established electrical practices to select the cables for drop lines and feeder cables with diameters (or gauge) based on their design currents as specified in the NEC2000 (EX1010). As a consequence, a POSITA would understand and consider it obvious that drop lines that carry less current should have smaller diameters than the higher-current carrying feeder cable, and therefore have a smaller diameter aperture within the connector that the aperture in the connector formed by the feeder cable. Therefore, a POSITA would find

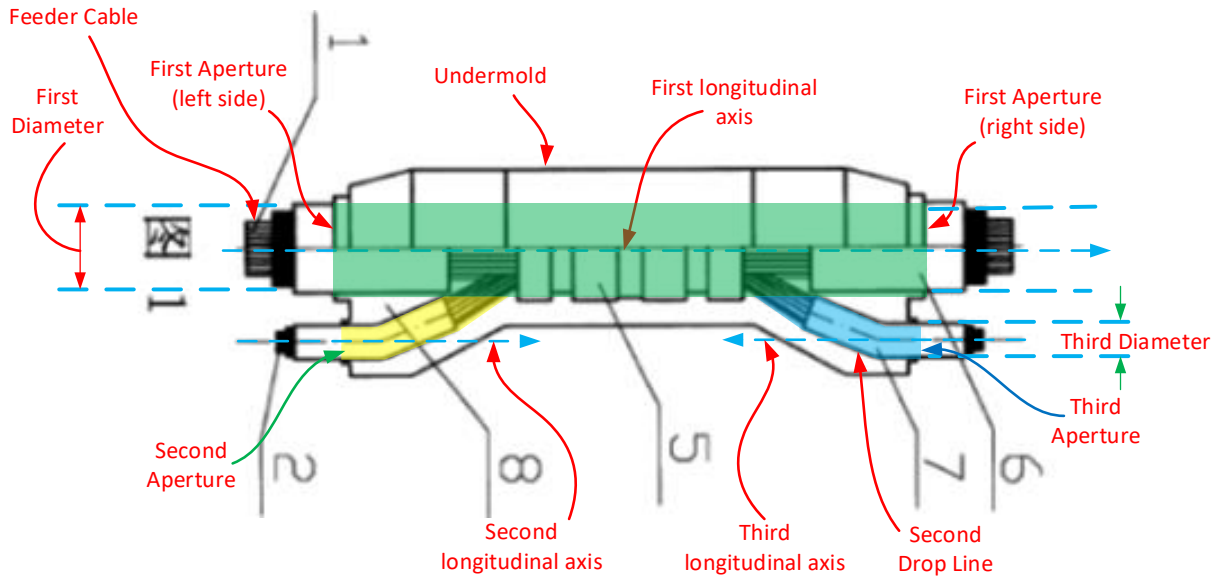
the claim language of the second diameter associated with the second aperture smaller than the first diameter associated with the first aperture to be obvious based on established electrical practices as well as the teachings in Shao (e.g., the dimensions visible in FIG. 1 reproduced above).

[409] For these reasons, a POSITA would have found the limitations in claim 9 to be obvious based on the Amphenol-Shao-Tamura combination.

8. Claim 10

The lead assembly of claim l, wherein the third longitudinal axis is substantially concentric with the second longitudinal axis, and substantially parallel with the first longitudinal axis.

[410] As discussed above regarding Ground 2, Shao discloses, and shows in an illustration reproduced below, that the third longitudinal axis is substantially concentric with the second longitudinal axis, and substantially parallel with the first longitudinal axis. *See* EX1008, (5th-annotation), reproduced below.



EX1008, FIG. 1 (5th-annotation)

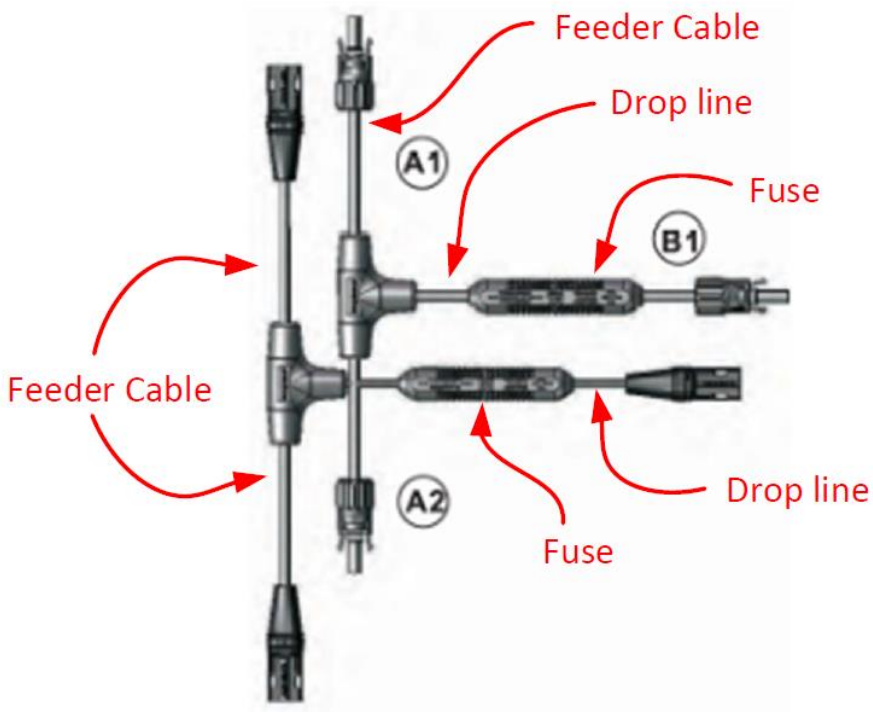
[411] As discussed in Shao, and would be understood by a POSITA, it is convenient for the drop lines to be arranged symmetrically and in parallel with the feeder cables in a solar installation, as this arrangement provides opportunities for cables to be routed in parallel and tied together so as to minimize the tangling and disorderly positioning of the cables in a large-scale installation. As discussed by Shao, "The branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear."

[412] For these reasons, a POSITA would have found the limitations in claim 10 to be obvious based on the Amphenol-Shao-Tamura combination.

9. Claim 11

The lead assembly of claim 1, wherein the drop line includes a fuse.

[413] As discussed above regarding Ground 2, Amphenol discloses, and shows in an illustration reproduced below, that the drop line includes a fuse. *See* EX1007, p. 13, top image (1st-annotation), reproduced below.



EX1007, p. 13, top image (1st-annotation)

[414] Additionally, Amphenol discloses, and shows in illustrations reproduced below, that a fuse may be connected to any cable in the assembly through connectors and/or including a fuse directly inline of any cable. *See* EX1007, p. 12, central image (a portion of which is reproduced below).



EX1007, p. 12, central image (right side)

[415] For these reasons, a POSITA would have found the limitations in claim 11 to be obvious based on the Amphenol-Shao-Tamura combination.

10. Claim 12

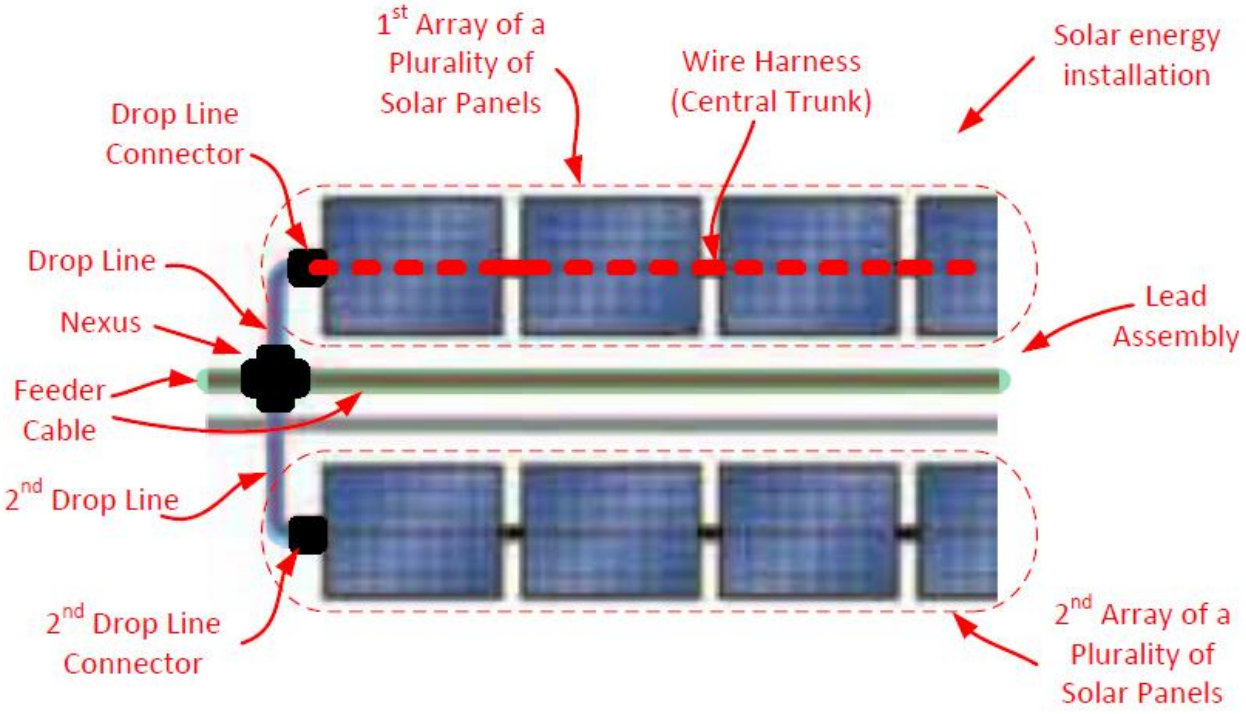
The lead assembly of claim 1, wherein said lead assembly combines power received from the plurality of solar panels and conducts that power directly to an inverter electrically connected to the feeder cable.

[416] The Ground 4, claim 12 limitations are the same as, at least equivalent to, or encompassed by the Ground 4, claim elements 1(a) and 1(b), and claim 6 that I addressed above. For the reasons presented above regarding the claim elements 1(a) and 1(b), and claim 6, which I incorporate here by reference, a POSITA would have found the claim 12 limitations to be obvious based on the Amphenol-Shao-Tamura combination.

11. Claim 13

The lead assembly of claim 1, wherein the second drop line terminates at a second drop line connector, the second drop line connector configured to connect with a central trunk of a second wire harness, the central trunk of the second wire harness having a plurality of branches the each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of solar panels.

[417] Amphenol, and shows in an illustration reproduced below, discloses that the second drop line terminates at a second drop line connector, the second drop line connector configured to connect with a central trunk of a second wire harness, the central trunk of the second wire harness having a plurality of branches the each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of solar panels. *See* EX1007, p. 5, middle image (Relief & 3rd-annotation), below.



EX1007, p. 5, middle image (Relief & 3rd-annotation)

[418] The diagrams provided by Amphenol enable a designer to design a cable harness system appropriate to match the solar array installation. In a case where the design includes a second wire harness associated with a second set of solar cells, a POSITA would understand that it is possible to configure elements, such as those shown in the illustration, along with other elements so as to enable a second drop line that terminates at a second drop line connector, where the second drop line connector is configured to connect with a central trunk of a second wire harness, and where the central trunk of the second wire harness has a plurality of branches where each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of

solar panels. Amphenol provides flexible building blocks (cables, junctions, connectors, fuses, etc.) that are designed to allow assembly into many different configurations. A POSITA would appreciate that examples explicitly shown in Amphenol are representative, and not intended to be the only possible combination of components or combination of components from Amphenol.

[419] A POSITA would have been motivated to combine Shao and Tamura with Amphenol to preserve the range of overall system designs enabled by Amphenol by providing the improved reliability and performance which is associated with the detailed junction design and undermold/overmold designs disclosed in Shao and Tamura.

[420] For these reasons, a POSITA would have found the limitations in claim 13 to be obvious based on the Amphenol-Shao-Tamura combination.

12. Claim 14

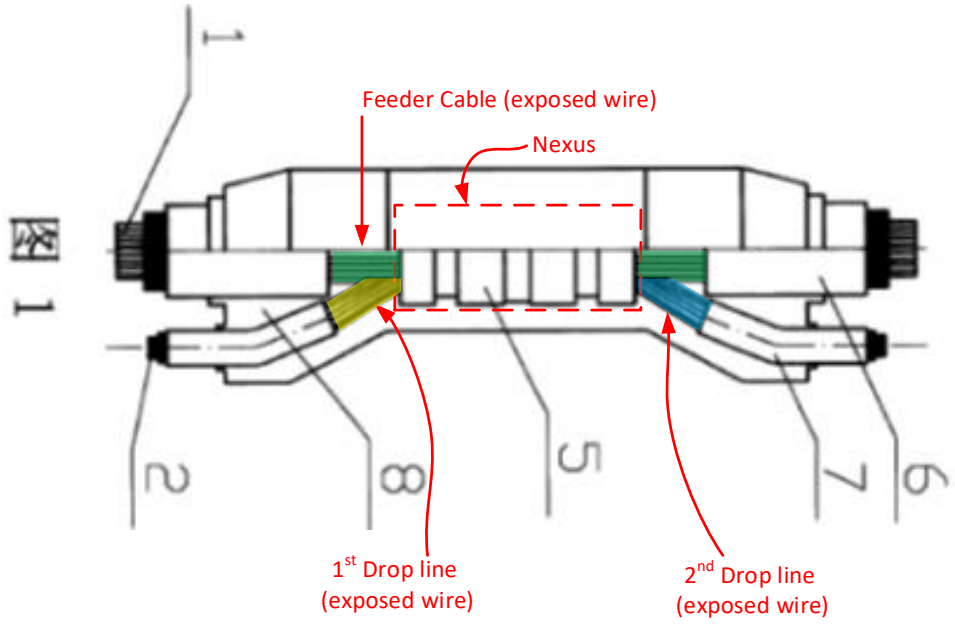
The lead assembly of claim 13, wherein the lead assembly is configured to combine electrical power received from the array of solar panels and the second array of solar panels at the *nexus* and to deliver the combined electrical power to an inverter that is in electrical communication with the feeder cable.

[421] The claim 14 limitations are equivalent to the claims 6, 12, and 13 limitations addressed above. For the reasons presented above regarding the claims 6, 12, and 13 limitations, which I incorporate here by reference, a POSITA would have found the claim 14 limitations to be obvious based on the Amphenol-Shao-Tamura combination.

13. Claim 15

The lead assembly of claim 1, wherein the second drop line includes a section of exposed wire at the nexus so as to be electrically connected to the feeder cable.

[422] As discussed above regarding Ground 2, Shao discloses, and shows in an illustration reproduced below, that the second drop line includes a section of exposed wire (colored blue in the annotation below) at the nexus so as to be electrically connected to the feeder cable (colored green in the annotation below). *See* EX1008, FIG. 1 (1st-annotation), reproduced below.



EX1008, FIG. 1 (1st-annotation)

[423] As discussed above with regard to claims 2 and 3, any cable junction that combines multiple cables must include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables.

[424] For these reasons, a POSITA would have found the limitations in claim 15 to be obvious based on the Amphenol-Shao-Tamura combination.

14. Claim 16

The lead assembly of claim 1, wherein the drop line and the second drop line each includes a wire of between four (4) to eighteen (18) gauge.

[425] As discussed above regarding Ground 2, Amphenol discloses that branch cable (i.e., drop line) gauge may be selected from 8AWG(10.0mm^2), 10AWG(10.0mm^2), 12AWG(10.0mm^2), and 14AWG(10.0mm^2), which a POSITA would understand to include a wire between four and eighteen gauge. *See* EX1007, p. 13 ("Branch cable size checklist"). A POSITA would understand that an appropriate drop line gauge should be selected for the intended use. In particular, a POSITA would understand that the maximum amount of current to be carried by a cable is an important parameter in selection of the cable diameter and other cable parameters, such as the cable material and the insulation material. In particular, there are well-known guidelines for cable diameter selection for different amounts of maximum current. For example, Table 310.16 of the NEC 2002, titled "Allowable Ampacities of Insulated Conductors Rated 0 Through 2000 Volts..." See EX1010, p. 149, reproduced below. This table is a wire ampacity size table with which any POSITA would be familiar and provides a guide for what gauge wire is appropriate for different ampacities of insulated conductors. *See id*. Table 310.16 shows that wire

gauges between 18 AWG and 4 AWG are expected to carry current from 14A to 95A at temperatures up to 90°C, and up to 70A at temperatures up to 60°C. *See id*. A POSITA would understand how to find and use engineering standards and guides, such as the NEC 2002, to make decisions about the diameter of the wire needed for different sections of a solar installation. Similar tables are available within the NEC 2002 with information on selection for different voltages, and for resistances.

Size AWG or kcmil	Temperature Rating of Conductor (See Table 310.13.)						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18	—	—	14	—	—	—	—
16	—	—	18	—	—	—	—
14*	20	20	25	—	—	—	—
12*	25	25	30	20	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	190	230	255	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000

EX1010, Table 310.16

[426] For these reasons, a POSITA would have found the limitations in claim 16 to be obvious based on the Amphenol-Shao-Tamura combination.

15. Claim 17

The lead assembly of claim 16, wherein the feeder cable includes a wire of between 250 MCM to 1000 MCM.

[427] As discussed above regarding Ground 2, A POSITA would understand that the abbreviation "MCM" stands for thousands of circular mils, which defines wire sizes. A typical 250 MCM cable would have a diameter of more than 1cm, and a 1000 MCM cable would have a diameter near 2.5 cm.

[428] The NEC2002 table 310.16 (reproduced above regarding claim 16) includes ampacity values for cables with 250 or 1000 MCM diameter; these are expected to carry current from 215A to 455A. Other than diameter and current carrying capacity, there are no differences between cables from 18 AWG to 1000MCM. A POSITA would understand how to find and use such guides to make decisions about the diameter of the wire needed for different sections of a solar installation, and to select such cables from the catalogs of suitable vendors. Similar tables are available with information on selection for different voltages, and for resistances. Therefore, a POSITA would understand that the selection of feeder cable size, in the range of 250 MCM to 1000 MCM is an obvious design choice based on the currents carried in feeder cables in view of cable selection guidance in Amphenol and established electrical practices defined in

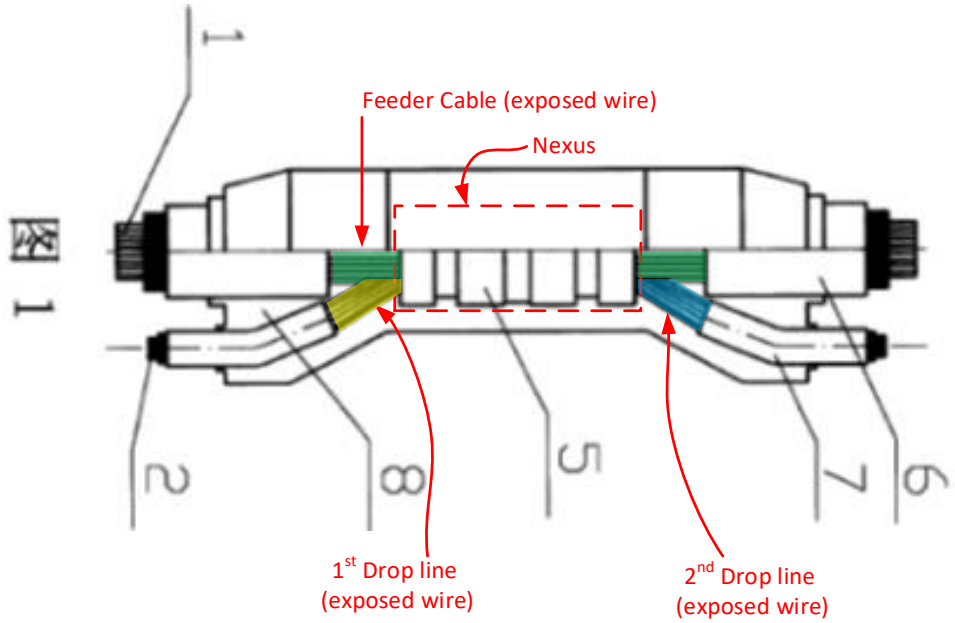
the NEC2002 EX1010.

[429] For these reasons, a POSITA would have found the limitations in claim 17 to be obvious based on the Amphenol-Shao-Tamura combination.

16. Claim 18

The lead assembly of claim 15, wherein the electrical coupling between the feeder cable, the drop line and the second drop line at the nexus is secured with at least one of a compression lug, a solder connection, a splice, and a crimp.

[430] As discussed above regarding Ground 2, Shao discloses, and shows in an illustration reproduced below, that "an elongated copper C-shaped clamp is used to form a K-shaped branch connector 5," which maintains an engagement between the feeder cable and the drops lines at the nexus. EX1008, p. 6:17-18 and EX1008, FIG. 1 (1st-annotation), below. A POSITA would recognize that a C-shaped clamp used to form an electrical connector as disclosed in Shao is equivalent to a "crimp."



EX1008, FIG. 1 (1st-annotation)

[431] As described by Shao, "The K-shaped branch connector is an elongated C-shaped clamp made of a copper material. The joint is formed by symmetrical overlapping and crimping of one trunk conductor and two branch-line conductors." EX1008, 5:10-13. Therefore, Shao discloses the use of crimping to form the nexus.

[432] For these reasons, a POSITA would have found the limitations in claim 18 to be obvious based on the Amphenol-Shao-Tamura combination.

17. Claim 19

The lead assembly of claim 1, wherein the undermold is applied by injection molding.

[433] As discussed above regarding Ground 2, Shao discloses a feeder cable's electrical coupling to drop lines at a nexus that is covered by a sheath made of

injection molding material, which is an undermold that fully encases the nexus. *See* EX1008, 5:15-20. A POSITA would recognize that an injection molded sheath (i.e., an undermold), as taught by Shao, encases the exposed cables and the metal clamp holding them together is better protected from damage and/or exposure (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed above).

[434] Similarly, Tamura discloses that, "the connecting section of the conductors 1a, 2a is arranged inside a cavity 101b of a forming die 101, and a molten resin (PE) is injected into the cavity 101b in order to mold the inside molded portion 11." EX1009, ¶20. A POSITA would recognize that an injection molded undermold (i.e., inside molded portion), as taught by Tamura, encases the exposed cables and the connection holding them together, which is better for protecting the assembly from damage and/or exposure. Therefore, it would be obvious to include an injection molded undermold, as disclosed by both Amphenol and Tamura.

[435] For these reasons, a POSITA would have found the limitations in claim 19 to be obvious based on the Amphenol-Shao-Tamura combination.

18. Claim 20

The lead assembly of claim 1, wherein the overmold is applied by injection molding.

[436] Shao discloses a feeder cable's electrical coupling to drop lines at a nexus

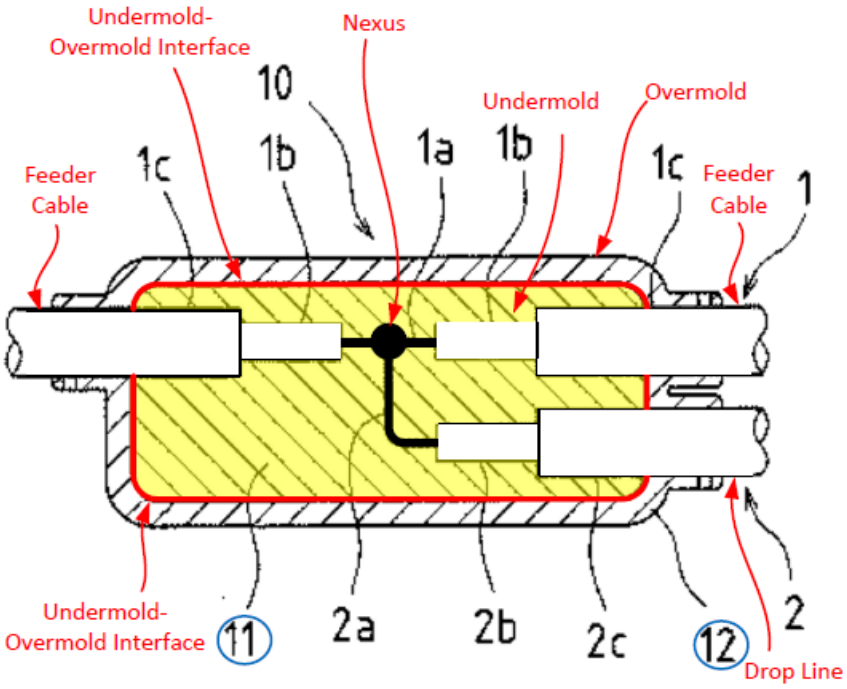
that is covered by a sheath made of injection molding material, which is an undermold that fully encases the nexus. *See* EX1008, 5:15-20. A POSITA would recognize that an injection molded sheath (i.e., an undermold), as taught by Shao, encases the exposed cables and the metal clamp holding them together is better protected from damage and/or exposure (*see* 'C(i) Motivation to Combine Amphenol and Shao' further discussed above).

[437] Tamura also teaches applying an overmold (i.e., outside molded portion 12) over an undermold (i.e., inside molded portion 11) of a drop line (i.e., branch cable) connection to provide an added layer of waterproofing. *See* EX1009, ¶¶15-17. In particular, Tamura discloses:

> [0015]
> PE is used for the resin of the inside molded portion 11. The inside molded portion 11 adheres to outer circumferential surfaces of the conductors 1a, 2a of the trunk cable 1 and the branch cable 2, and the insulators 1b, 2b (also including a portion of the sheath materials 1c, 2c) of the cables.
> [0016]
> PVC is used for the resin of the outside molded portion 12. The outside molded portion 12 adheres to the outer circumferential surfaces of the sheath materials 1c, 2c of the trunk cable 1 and the branch cable 2.
> [0017]
> According to this embodiment, the same resin (PE) as that of the insulators 1b, 2b of the CV cable is thus used as the resin of the inside molded portion 11, which therefore improves adhesion between the inside molded portion 11 and the insulators 1b, 2b. Additionally, the same resin (PVC) as that of the sheath materials 1c, 2c of the CV cable is used as the resin of the outside molded portion, which therefore also improves adhesion between the outside molded portion 12 and the sheath materials 1c, 2c. This makes it possible to achieve high waterproofing performance by virtue of a double waterproofing effect.

Id.

[438] Accordingly, Tamura describes an undermold formed of PV and an overmold formed of PVC, as described above in the excerpt from Tamura describing Fig. 1, shown below.



EX1009, Fig. 1 (1st-annotation)

[439] In addition, to the combination of Amphenol and Shao discussed above, the POSITA would further be motivated to combine the solar power system and connectors as taught by Amphenol and modified by Shao with the multi-layered protective arrangement taught by Tamura in order to provide a compact, layered casing that better protects the solar power system branch connectors against the elements. Further, a POSITA would have an expectation of success in making

the Amphenol-Shao-Tamura combination since these references complement one another by further protecting and strengthening solar power system branch connections.

[440] Specifically, Tamura goes on to explain that the double-molding described in this disclosure can be applied broadly, "…the present invention may also be applied to molding of branch portions for various types of cables used for connecting electrical devices such as modules for snow melting purposes and modules for tape heaters." (Tamura paragraph 25).Thereby, Tamura is explicitly encouraging POSITAs to apply the details disclosed in Tamura broadly, which would motivate and indicate likely success to a POSITA.

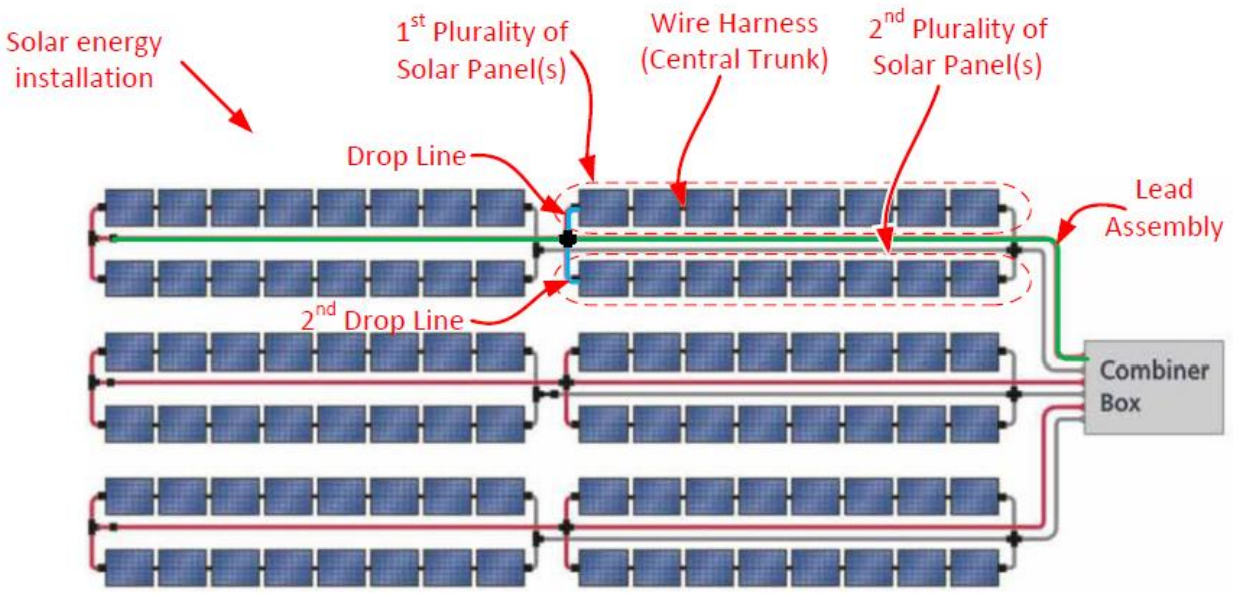
[441] Further, a POSITA would have understood to achieve these advantages, the selection of "PVC resins" for several of the layers of the assembly, and the use of an inner mold part and an outer mold part disclosed by Tamura could be successfully applied to the modified harness of Amphenol-Shao.

[442] For these reasons, a POSITA would have found the limitations in claim 20 to be obvious based on the Amphenol-Shao-Tamura combination.

19. Claim 21

Preamble. A solar power system comprising:

[443] As discussed above regarding Ground 2, Amphenol discloses a solar energy installation (i.e., a solar power system). *See* EX1007, p. 5, middle image (1st-annotation), below.



EX1007, p. 5, middle image (1st-annotation)

[444] For these reasons, a POSITA would have found the limitations in claim 21(Preamble) to be obvious based on Amphenol.

a. a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness to form a first solar array;

[445] As discussed above regarding Ground 2, claim element 1(a), which reasons are incorporated herein by reference, Amphenol discloses a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness to form a first solar array. *See* EX1007, p.6, middle image (1st-annotation), above.

[446] For these reasons, a POSITA would have found the limitations in claim 21(a) to be obvious based on Amphenol.

b. a lead assembly comprising:

[447] The claim 21(b) limitations are the same as or at least equivalent to the claim 1(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b) limitations to be obvious based on Amphenol.

i. a drop line electrically connected to a central trunk of the wire harness and configured to receive power from the plurality of solar panels;

[448] As discussed above with regard to the claim 1(a) limitations, Amphenol discloses that the drop line connector is connected to a central trunk of a wire harness, and the central trunk of the wire harness inherently has a plurality of branches that each electrically connect to separate solar panels that together are a part of an array of a plurality of solar panels. For the reasons presented above regarding the claim 1(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(i) limitations to be obvious based on Amphenol.

ii. a second drop line electrically connected to a central trunk of a second wire harness and configured to receive power from a plurality of solar panels in a second solar array;

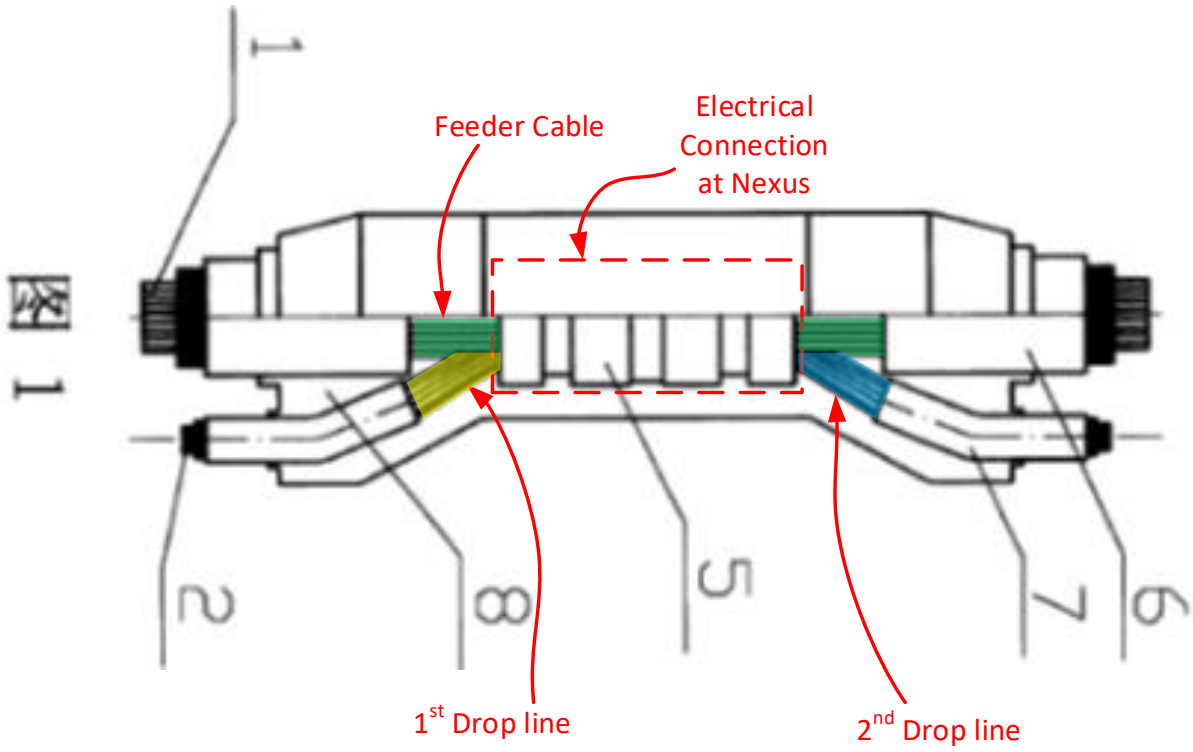
[449] As discussed above with regard to the claim elements 1(c)(iii) and claim 13 limitations, the Amphenol-Shao-Tamura combination discloses a second drop line electrically connected to a central trunk of a second wire harness and

configured to receive power from a plurality of solar panels in a second solar array. For the reasons presented above regarding claim elements 1(c)(iii) and claim 13 limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(ii) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

iii. a feeder cable, the feeder cable electrically connected to the drop line and the second drop line at a nexus; and

[450] As discussed above with regard to the limitations of claim elements 1(b) and 1(c)(iii) and claim 18, Amphenol discloses a feeder cable electrically connected to the drop line and the second drop line at a nexus. See my full explanation of the relevant disclosures of the Amphenol-Shao-Tamura combination in the discussion of the claim elements 1(b) and 1(c)(iii) and claim 18 limitations, which I incorporate here by reference.

[451] In particular, Shao discloses a feeder cable electrically connected to the drop line and the second drop line at a nexus. *See* EX1008, FIG. 1 (6th-annotation), below.



EX1008, FIG. 1 (6th-annotation)

[452] For these reasons, a POSITA would have found the limitations in claim 21(b)(iii) to be obvious based on the Amphenol-Shao-Tamura combination.

iv. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[453] As discussed above with regard Ground 2, the term "primary mold" in the '153 Patent claims would be understood by a POSITA to mean a "m material molded over a piece or part that seals against environmental factors." *See* EX1001, FIGS. 48, 54, 55, 60 and generally; and EX1017, 17:8-11, 20:14-15, 37:16-19.

[454] Thus, the claim 21(b)(iv) limitations are the same as or at least equivalent to

the claim elements 1(c) and claim 18 limitations addressed above. For the reasons presented above in this Ground 4 for the claim elements 1(c) and claim 18 limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(iv) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

> **(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture;**
>
> **(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture and**
>
> **(3) a third aperture extending partially through the primary mold and having a third diameter smaller than the first diameter, wherein the second drop line extends into the third aperture.**

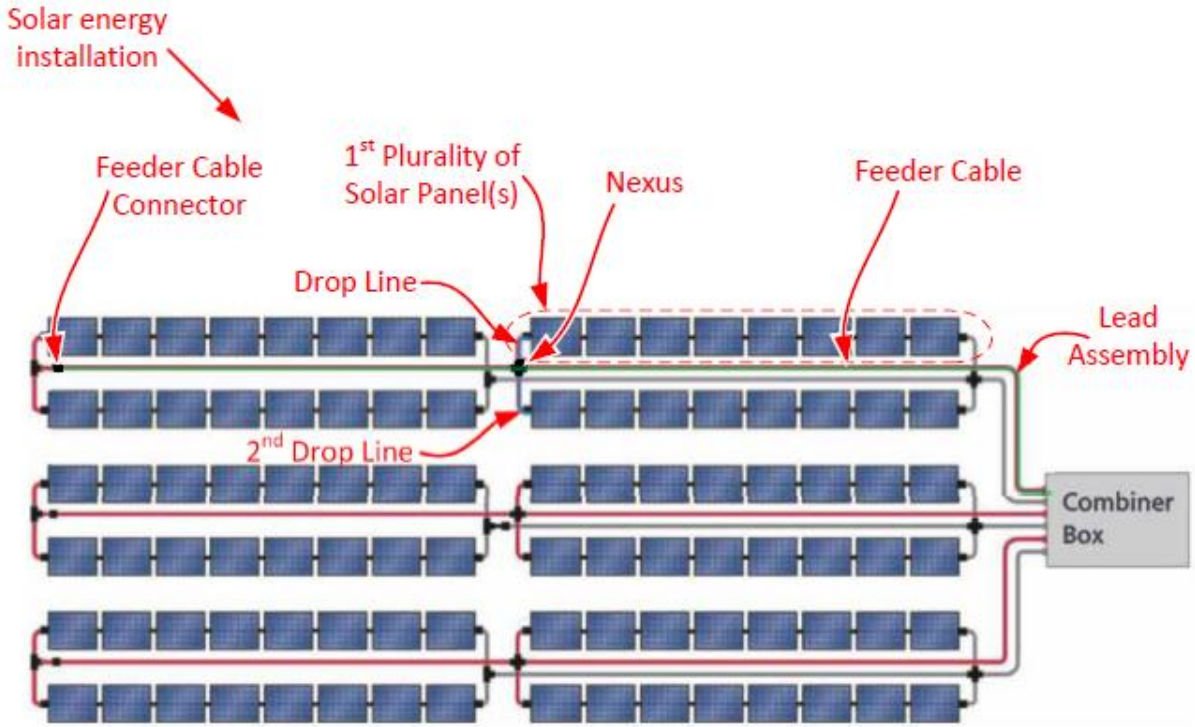
[455] The claim 21(b)(iv)(1-3) limitations are the same as or at least equivalent to the claim 1(c)(i)-(iii) limitations addressed above in Ground 4. For the reasons presented in Ground 4 for the claim 1(c)(i)-(iii) limitations, which I incorporate here by reference. Although the claim elements 21(b)(iv)(2) and 21(b)(iv)(3) refer to "smaller" diameters, in contrast to claim elements 1(c)(ii) and 1(c)(iii), which refer to "different" diameters, reciting that two apertures have different diameters implies a comparison where one aperture must necessarily have a smaller diameter than the other. For these reasons and the ones presented regarding the claim 1(c)(i)-(iii) limitations, a POSITA would have found the

claim 21(b)(iv)(1-3) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

20. Claim 22

The solar power system of claim 21, wherein the feeder cable is directly electrically connected to a component selected from the group consisting of a trunk buss jumper, an inverter, a connection unit, a recombiner, and a disconnect unit.

[456] Amphenol discloses that the feeder cable is directly electrically connected to a recombiner (i.e., combiner box). EX1007, p. 5, middle image (2nd-annotation), reproduced below.



EX1007, p. 5, middle image (2nd-annotation)

[457] For these reasons, a POSITA would have found the claim 22 limitations to be obvious based on the Amphenol-Shao-Tamura combination.

21. Claim 23

The solar power system of claim 21, further comprising a secondary mold surrounding the primary mold and forming an undermold-overmold interface at an outer surface of the primary mold.

[458] The claim 23 limitations are the same as or at least equivalent to the claim 1(d) limitations addressed above in this Ground 4. For the reasons presented above for the claim 1(d) limitations, which I incorporate here by reference, a POSITA would have found the claim 23 limitations to be obvious based on the Amphenol-Shao-Tamura combination.

22. Claim 24

Preamble. A solar power system comprising:

[459] The claim 24(Preamble) limitations are the same as or at least equivalent to the claim 1(Preamble) or claim 21(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) or claim 21(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(Preamble) limitations to be obvious based on Amphenol.

a. a plurality of solar panels electrically coupled by a wire harness to form a first solar array;

[460] The claim 24(a) limitations are the same as or at least equivalent to the claim 21(a) limitations addressed above. For the reasons presented above regarding the claim 21(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(a) limitations to be obvious based on

Amphenol.

b. a lead assembly comprising:

[461] The claim 24(b) limitations are the same as or at least equivalent to the claim 1(Preamble) or claim 21(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) and/or claim 21(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b) limitations to be obvious based on Amphenol.

i. a first drop line electrically connected to the wire harness and configured to receive power from the plurality of solar panels;

[462] The claim 24(b)(i) limitations are the same as or at least equivalent to the claim element 1(a) limitations addressed above. For the reasons presented above regarding the claim element 1(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(i) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

ii. a feeder cable, the feeder cable electrically connected to the drop line at a nexus;

[463] The claim 24(b)(ii) limitations are the same as or at least equivalent to the claim element 1(b) limitations addressed above. For the reasons presented above regarding the claim element 1(b) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(ii) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

iii. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[464] The claim 24(b)(iii) limitations are the same as or at least equivalent to the claim 1(c) or claim 18 limitations addressed above. For the reasons presented above regarding the claim 1(c) and/or claim 18 limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iii) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis;

[465] The claim 24(b)(iii)(1) limitations are the same as or at least equivalent to the claim element 1(c)(i) limitations addressed above. For the reasons presented above regarding the claim element 1(c)(i) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iii)(1) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture along a second longitudinal axis; and

[466] The claim 24(b)(iii)(2) limitations are the same as or at least equivalent to the claim element 1(c)(ii) limitations addressed above. For the reasons presented above regarding the claim element 1(c)(ii) limitations, which I

incorporate here by reference, a POSITA would have found the claim 24(b)(iii)(2) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

iv. a second drop line electrically connected to a second wire harness that connects to a plurality of solar panels, the second drop line electrically connected to the feeder cable at the nexus fully encased by the primary mold, wherein the second drop line extends into a third aperture defined by the primary mold along a third axis.

[467] The claim 24(b)(iv) limitations are the same as or at least equivalent to the claim element 1(c)(iii) limitations addressed above. For the reasons presented above regarding the claim element 1(c)(iii) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iv) limitations to be obvious based on the Amphenol-Shao-Tamura combination.

[468] In sum, for all of the reasons discussed above regarding Ground 4, it is my opinion that a POSITA would have found claims 1-3, 5, 6, and 8-24 to be obvious based on Amphenol, Shao, and Tamura.

E. Ground 5: Claims 1-3, 5-10, 12-15, 18, 19, and 21-24 are unpatentable under 35 U.S.C. § 103 as obvious in view of Yamawaki and Shao.

(i) Motivation to Combine Yamawaki and Shao

[469] Yamawaki and Shao are both concerned with wire harnesses, cable junctions, connectors, and other components to be used for combining power

from elements of a solar array installation. Yamawaki is concerned with photovoltaic modules that may be arranged in various ways to overcome challenges and support the design of a photovoltaic panel array, such as on a home solar energy installation. EX1006, 7:54-8:11. Shao is concerned with the detailed design of a cable junction to be used for power distribution in a large-scale facility. EX1008, Abstract. These references discuss the design of cable junction elements that can be used to combine or distribute electrical power including solving the same problems as the '153 Patent including forming a reliable electrical contact between different cables, protecting the connection from environmental factors and damage, and providing the structures in a way that reduces cost and simplifies the assembly and maintenance of the power facilities. These references discuss the design of cable junction elements that can be used to combine or distribute electrical power and are, thus, in the same field of endeavor as the '153 Patent. Therefore, both Yamawaki and Shao are analogous prior art to the '153 Patent.

[470] A POSITA would have been motivated to combine Yamawaki with Shao (the "Yamawaki-Shao combination") because both references address the general problem of providing convenient, flexible, reliable, and low-cost wiring harnesses. EX1006, 2:64-65. Shao more specifically teaches that "the connection reliability of the branch joint is improved compared with an existing

product; the joint has good sealing performance, and is moisture-proof, waterproof, maintenance-free and stable in performance." EX1008, 5:38-41. Also, Shao teaches improvements to branch junctions that can provide, "[t]he branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear." EX1008, Abstract.

[471] In particular, the benefits of the undermold of Shao include "improved reliability", prolonged "service life", with "good sealing performance"; and the benefits of the cover member (overmold) of Yamawaki include "…it is so water resistant that the reliability of the wiring apparatus 16 and 17 to resist penetration of water can be improved." EX1008, 5:28-32; EX1006, 13:15-18. A POSITA would understand that the combination of the undermold of Shao and the overmold of Yamawaki would provide complimentary and additive benefits, and that the sum of the benefits of the individual molds would lead to an improved product. In this way, Shao teaches branch junctions that provide an undermold configuration that a POSITA would have been motivated to incorporate into Yamawaki by replacing the protective sheath of Yamawaki to provide better sealing and a smaller profile for installation.

[472] Yamawaki is focused on solar arrays and Shao is focused on power distribution, so a POSITA would have understood that the underlying

mechanics, materials, assembly processes, molding processes, and other details that are compatible and familiar elements in the art. Therefore, a POSITA would have an expectation of success in combining the teachings of Yamawaki and Shao because the components are versions of well-known wiring components designed for use in the field and do not involve unpredictable technology.

[473] A POSITA would understand that the solar power system connectors disclosed by Yamawaki could be designed and manufactured using the materials, design, and processes disclosed by Shao, such as the details associated with overlapping and crimping the cable and drop lines within the assembly, which ensures contact (i.e., conductivity) between the feeder cable and the drop lines. Additionally, Shao discloses using insulation layers and injection molding to form the packaging around the nexus of the cables. The wire harness and lead assembly designs disclosed by Yamawaki would obviously benefit from the features disclosed by Shao, as related to the design and manufacture of the K-shaped branch structure shown in FIG. 1 from Shao, which provide "good insulation performance, heat resistance stability and overheating aging performance." *See* EX1008, 6:40-7:1. A POSITA would consider the use of details provided by Shao to form the branch elements in the broader variety of cable assemblies disclosed by Yamawaki in order to capture

the features and benefits of the Shao junctions throughout the harnesses of Yamawaki. In particular, the details in Shao associated with overlapping and crimping the cable and drop lines within the assembly and using insulation layers and injection molding to form the packaging around the nexus of the cables would be understood to provide a concise installation with increased service life.

[474] As described by Shao, the K-shaped branch connector structure "can realize double branch power distribution via a single branch joint. The branch wire respectively outgoes in two opposite directions of the branch joint and can respectively lead to two floor distribution boxes. The bending and turning of the branch wire is unnecessary, which causes one branch joint to be reduced, the installation space occupation to be little and the wire to be concise." EX1008, Abstract. A POSITA would appreciate that the structure of the K-shaped branch connector provides useful additional benefits that could be incorporated by modifying Yamawaki to include the K-shaped connectors disclosed by Shao.

[475] Also, a POSITA would have an expectation of success in combining Yamawaki and Shao, since Shao complements the disclosure of Yamawaki by disclosing design and materials that are appropriate choices for these junctions while also providing alternative connector configurations and advantages thereof. A POSITA that selects components for a solar energy installation and

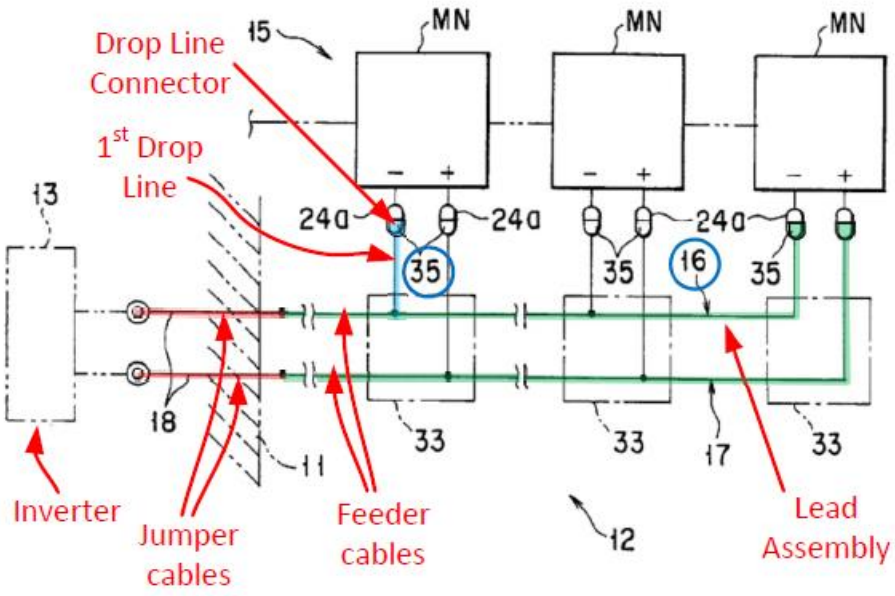
performs the installation would be familiar with the families of components, wire harnesses and lead assemblies disclosed in Yamawaki, and would appreciate the benefits of the details provided by Shao in design and manufacturing of reliable and easily utilized branch structures.

[476] For these reasons, a POSITA would be motivated to combine the teachings of Yamawaki and Shao because the solar photovoltaic power generation systems disclosed by Yamawaki are intended for use in a harsh outdoor environment and would benefit from added protection from the elements and improved reliability for the branch structures provided by the design and manufacturing processes disclosed in Shao.

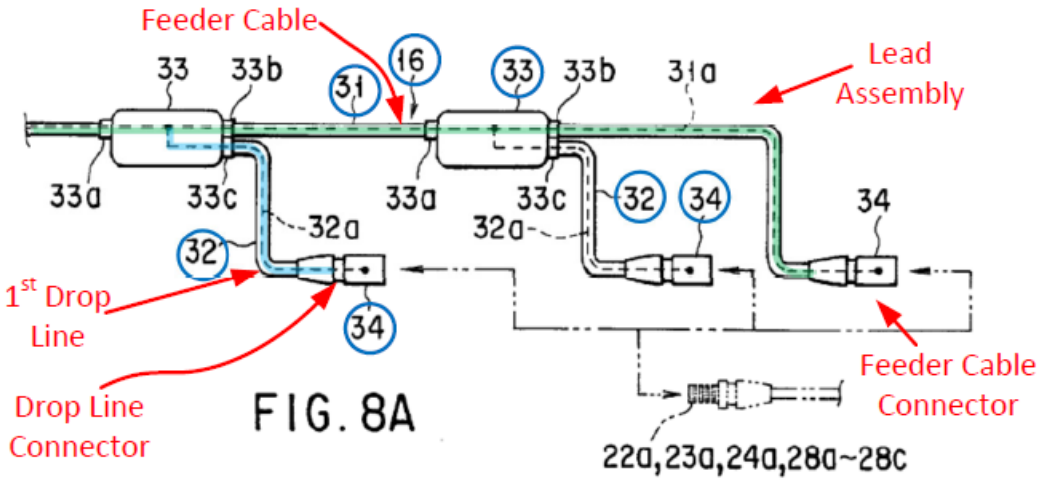
1. Claim 1

Preamble. A lead assembly for use in a solar energy installation including:

[477] Yamawaki discloses a lead assembly (e.g., wiring apparatus 16, annotated in green and blue below) for use in a solar energy installation. *See* EX1006, 8:12-15, 9:57-63, FIG. 2 (1st-annotation), and FIG. 8A (1st-annotation), below.



EX1006, FIG. 2 (1st-annotation)

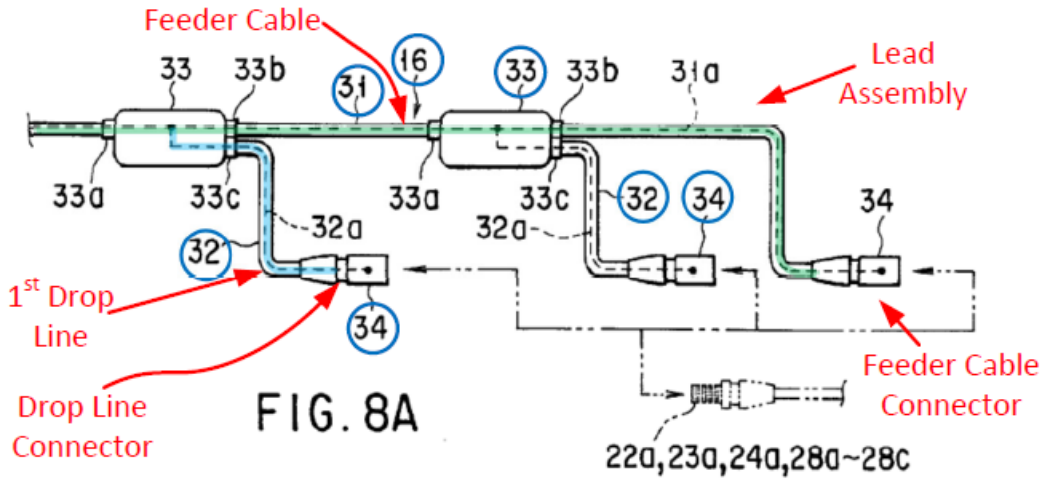


EX1006, FIG. 8A (1st-annotation)

[478] For these reasons, a POSITA would have found the limitations in claim 1(Preamble) to be obvious based on Yamawaki.

a. a drop line terminating at a drop line connector, the drop line connector configured to connect with a central trunk of a wire harness, the central trunk of the wire harness having a plurality of branches that each are configured to electrically connect to a separate solar panel contained in an array of a plurality solar panels;

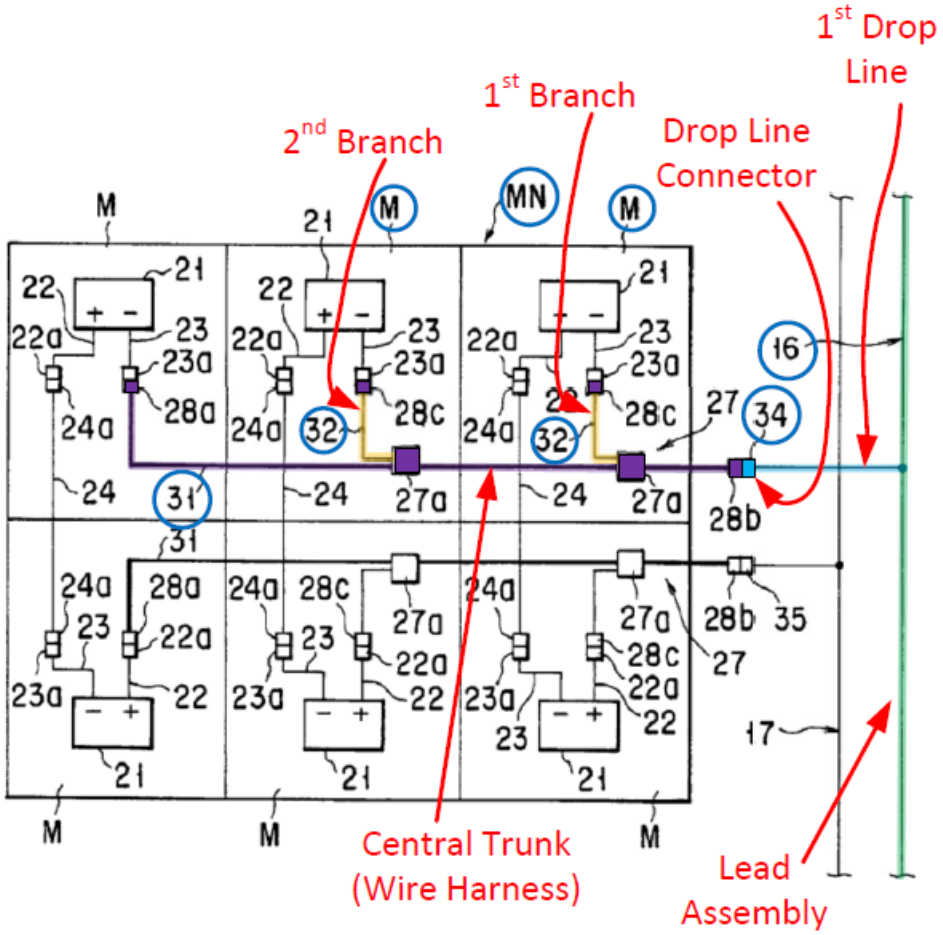
[479] Yamawaki discloses, and shows in an illustration reproduced below, that the lead assembly (e.g., wiring apparatus 16) is formed by a feeder cable (e.g., trunk cable 31 – annotated in green, below), one or more branch junctions (e.g., branch junction 33), and one or more drop lines (e.g., branch cable 32 – annotated in blue, above and below) that branches off the feeder cable of the lead assembly, where the drop lines each terminate in a drop line connector (connector 34). *See* EX1006, 11:3-13 and FIG. 8A (1st-annotation), below.



EX1006, FIG. 8A (1st-annotation)

[480] Additionally, as shown below, Yamawaki discloses, and shows in an illustration reproduced below, that the drop line connector (i.e., connector 34) is connected to a central trunk (i.e., trunk cable 31 – annotated in purple, below)

of a wire harness (i.e., wiring apparatus 27) and the central trunk of the wire harness has a plurality of branches (i.e., branch cables 32 – annotated in yellow, below) that each electrically connect to separate solar panels (modules M) that together are a part of module units MN, which form an array of a plurality of solar panels. *See id*., 8:43-57 and FIG. 7 (1st-annotation), below.

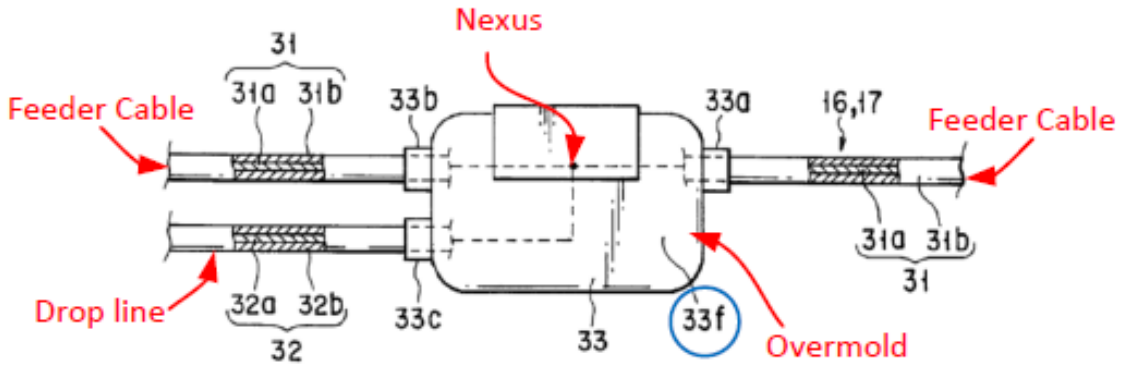


EX1006, FIG. 7 (1st-annotation)

[481] For these reasons, a POSITA would have found the limitations in claim 1(a) to be obvious based on Yamawaki.

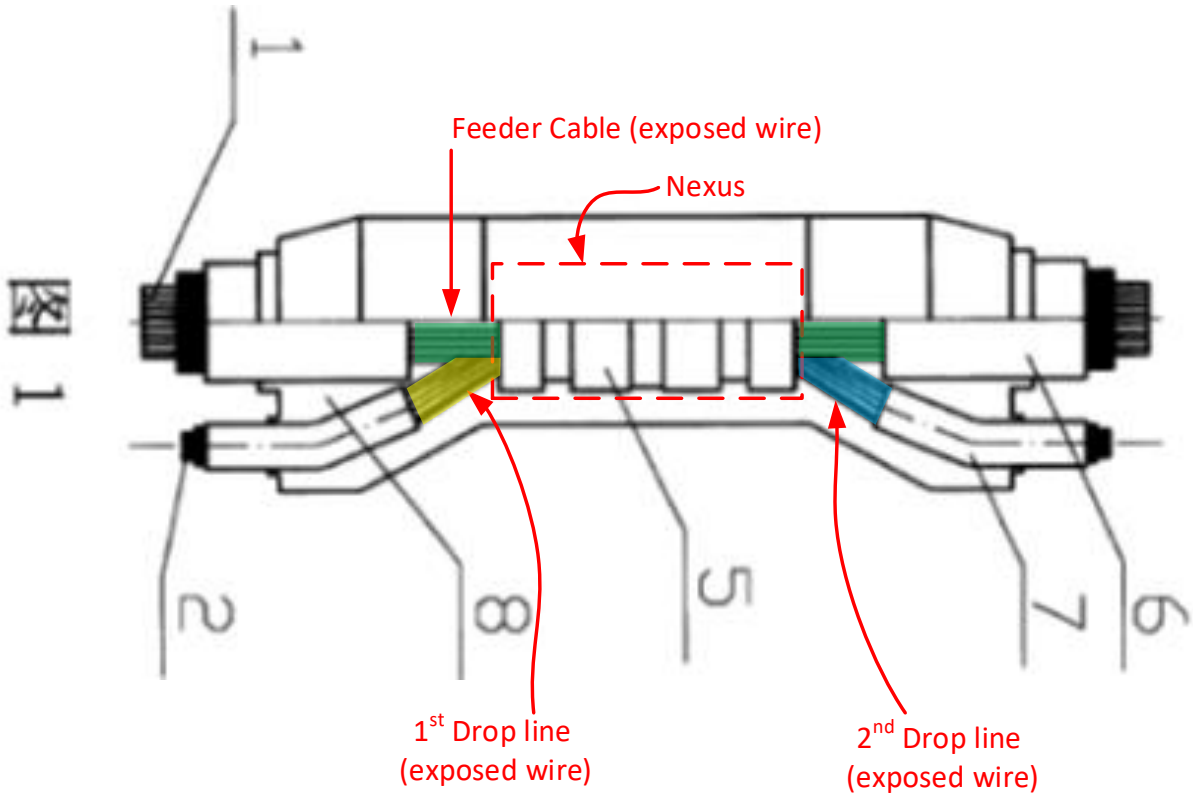
b. a feeder cable electrically coupled to the drop line at a nexus;

[482] Yamawaki discloses the electrical coupling of the feeder cable (i.e., trunk cable 31) and the drop line (i.e., branch cable 32) at a nexus. *See* EX1006, FIG. 9A (1st-annotation), below.



EX1006, FIG. 9A (1st-annotation)

[483] To the extent that Yamawaki does not illustrate the details of the electrical coupling between the feeder cable and drop line that is inside the illustrated branch junction. Shao illustrates details of the feeder cable's (i.e., trunk conductor 1) electrical coupling to the drop line (i.e., branch line conductor 2) at the nexus, along with details associated with the encapsulation of the junction to provide protection from the external environment. Shao, which is in the related field of electrical connectors, discloses a feeder cable (i.e., trunk conductor 1) electrically coupled to the drop line (i.e., branch line conductor 2) at a nexus that includes a clamp (i.e., connector 5) holding the feeder cable in contact with the drop line. *See* EX1008, FIG. 1 (1st-annotation), below.



EX1008, FIG. 1 (1st-annotation)

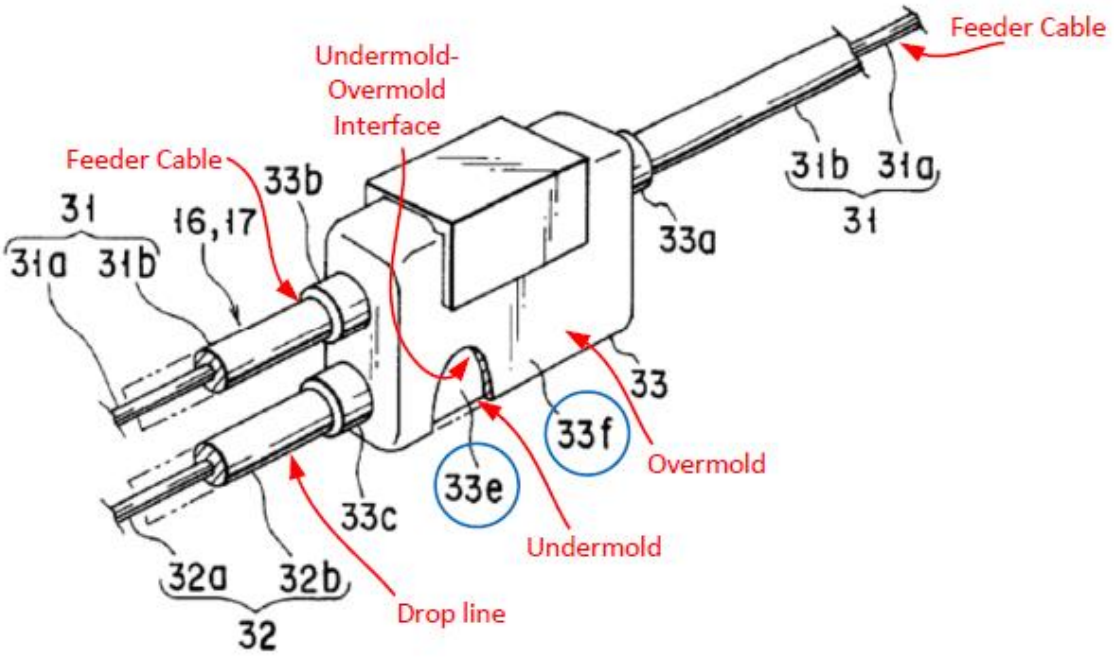
[484] As illustrated, Shao discloses a nexus configuration with a clamp, as taught by Shao, to ensure contact and good conductivity is maintained between the two conductive elements (*see* 'F(i) Motivation to Combine Yamawaki and Shao' further discussed above).

[485] For these reasons, a POSITA would have found the limitations in claim 1(b) to be obvious based on the Yamawaki-Shao combination.

c. an undermold that fully encases the nexus, the undermold further comprising:

[486] Yamawaki discloses an undermold (i.e., molded body 33e) that fully encases the nexus, discussed above regarding claim 1(b). *See* EX1006, 10:19-32 and

13:15-18. In particular, Yamawaki discloses that "each junction 33 includes a molded body 33e of an electrically insulating synthetic resin material and a cover member 33f that covers the outer surface of the body 33e. … In each branch junction 33, the trunk conductor 31a and the branch conductor 32a are connected electrically to each other." *Id.* This disclosure is supported by FIG. 9B, an annotated version of which is reproduced below. *See* EX1006, FIGS. 9B (1st-annotation).

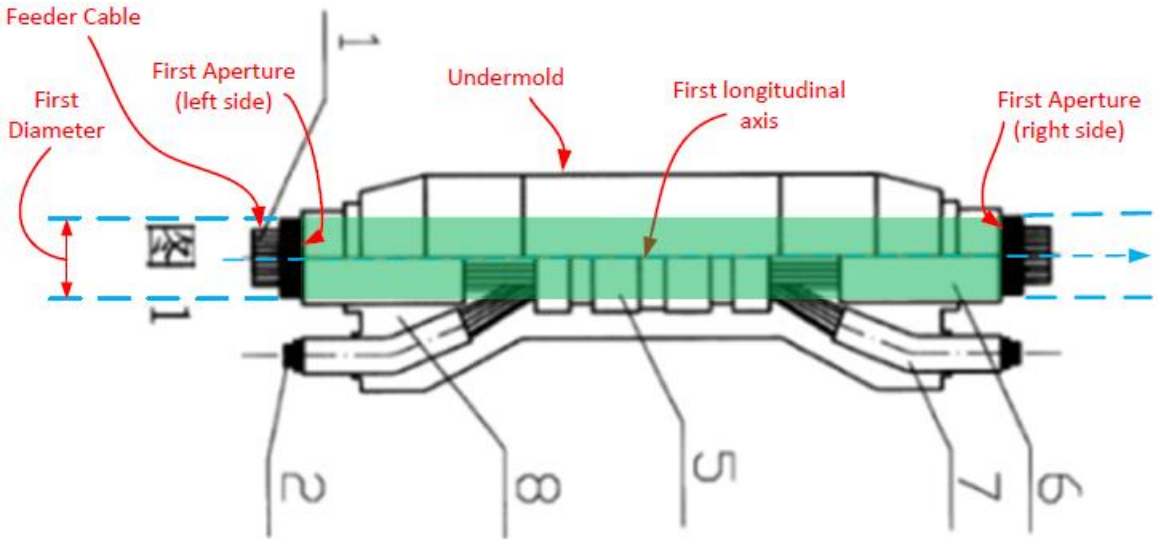


EX1006, FIG. 9B (1st-annotation)

[487] For these reasons, a POSITA would have found the limitations in claim 1(c) to be obvious based on Yamawaki.

i. a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis; and

[488] As discussed above, Yamawaki discloses, and shows in an illustration reproduced below, that the feeder cable extends completely through the undermold (i.e., the junction), along a first axis, as well as an undermold fully encases the nexus. In this regard, Shao also discloses that a first aperture of the undermold (i.e., connector outer sheath 8) extends completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis. *See* EX1008, (2nd-annotation), below.



EX1008, FIG. 1 (2nd-annotation)

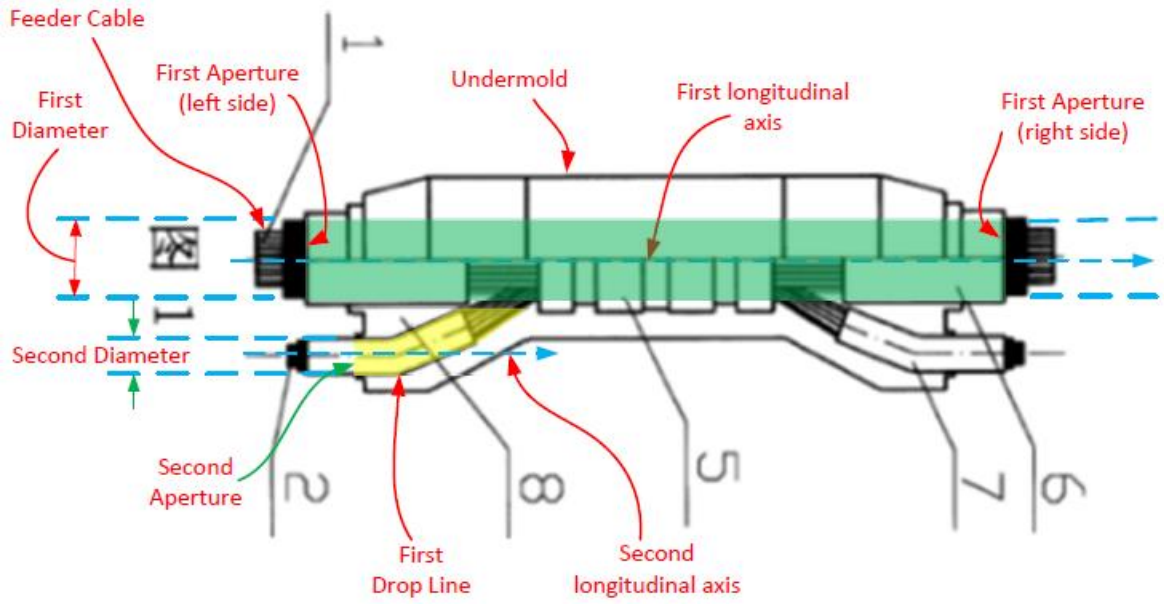
[489] A POSITA considering Yamawaki and Shao would appreciate that these two disclosures describe methods for encasing cable junctions with insulating layers

that can provide protection from the environment and other benefits discussed earlier with respect to Shao (*see* 'F(i) Motivation to Combine Yamawaki and Shao' discussed above). A POSITA considering Yamawaki and Shao would have found it obvious to replace the specific undermold design used by Yamawaki with that taught by Shao in order to provide a low profile branch connection with added protection against environmental elements (e.g., waterproofing), as taught by Shao (*see* 'F(i) Motivation to Combine Yamawaki and Shao' discussed above). In particular, the benefits disclosed by Shao of its undermold include "the connection reliability of the branch joint is improved compared with an existing product; the joint has good sealing performance, and is moisture-proof, waterproof, maintenance-free and stable in performance." EX1008, 5:37-40. These benefits compliment those of Yamawaki, which attempts to achieve benefits including "reliability of water proofing of branch junctions." EX1006, 2:64-65. A POSITA would understand that the combination of the undermold of Shao and the overmold of Yamawaki would provide complimentary and additive benefits, and that the sum of the benefits of the individual molds would lead to an improved product.

[490] For these reasons, a POSITA would have found the limitations in claim 1(c)(i) to be obvious based on the Yamawaki-Shao combination.

ii. a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis;

[491] Shao discloses a second aperture extending partially through the undermold (i.e., connector outer sheath 8) and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis. *See* EX1008, FIG. 1 (3rd-annotation), below.



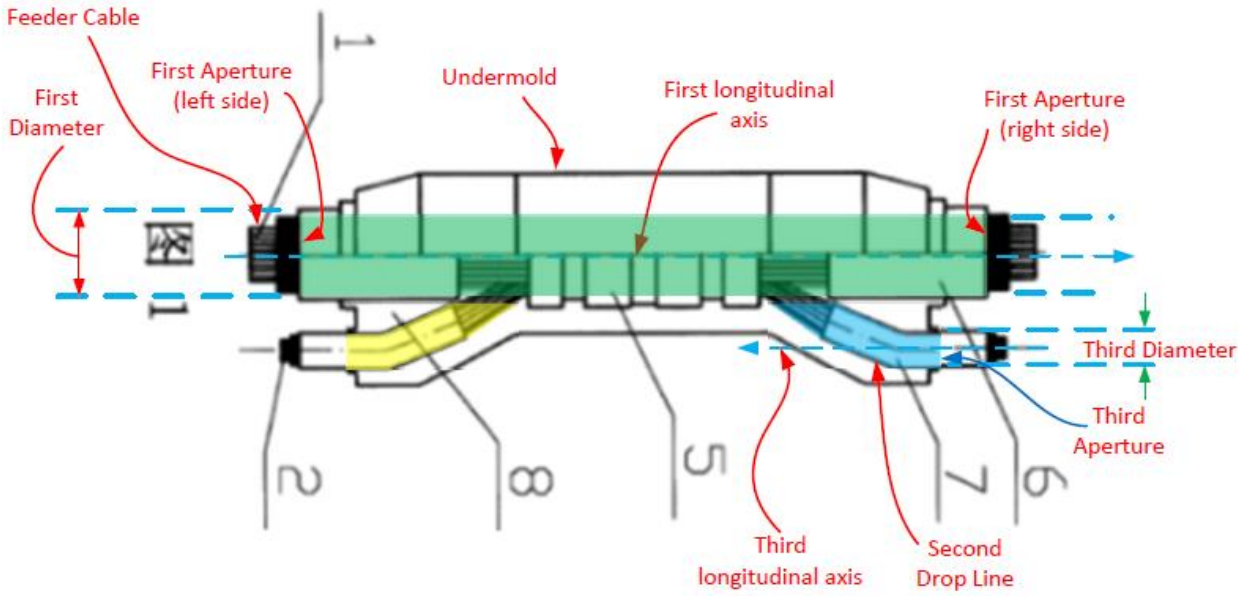
EX1008, FIG. 1 (3rd-annotation)

[492] For these reasons, a POSITA would have found the limitations in claim 1(c)(ii) to be obvious based on the Yamawaki-Shao combination.

iii. a third aperture extending partially through the undermold and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis; and

[493] Shao discloses a third aperture extending partially through the undermold

(i.e., connector outer sheath 8) and having a third diameter different than the first diameter, wherein a second drop line extends from the third aperture along a third longitudinal axis. *See* EX1008, FIG. 1 (4th-annotation), below.



EX1008, FIG. 1 (4th-annotation)

[494] Shao specifically discloses the connection of "One trunk conductor and two branch-line conductors are symmetrically overlapped and crimped by means of the K-shaped branch connector 5 to form one joint and two branch-line conductor out-leads." EX1008, 6:18-21. Shao discloses a feeder cable (i.e., single trunk conductor 1) and a pair of drop lines (i.e., branch line conductors 2) that are brought together by the crimp (connector 5) to form the junction. *See* EX1008, FIG. 1 (4th-annotation), above. This arrangement provides for a first aperture (through which the trunk conductor extends) and a second and third

aperture (through which the two branch-line conductors extend).

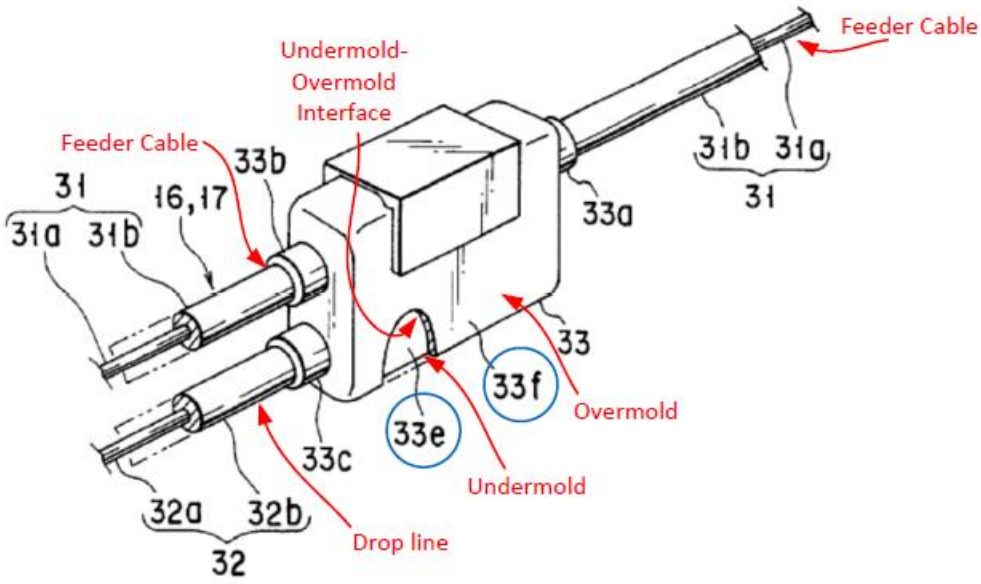
[495] A POSITA considering the lead assembly disclosed by Yamawaki would be motivated to replace the two branch junctions (33) with a single low-profile bi-directional K-shaped branch taught by Shao to reduce the number of junctions needed for the assembly. As described by Shao, the K-shaped branch connector structure "can realize double branch power distribution via a single branch joint. The branch wire respectively outgoes in two opposite directions of the branch joint and can respectively lead to two floor distribution boxes. The bending and turning of the branch wire is unnecessary, which causes one branch joint to be reduced, the installation space occupation to be little and the wire to be concise." *See* EX1008, Abstract. A POSITA would appreciate that the structure of the K-shaped branch connector provides useful additional benefits that could be incorporated by modifying Yamawaki to include the K-shaped connectors disclosed by Shao. Further, a POSITA would appreciate that the formation of the cover member of Yamawaki could be carried out upon the K-shaped connector disclosed by Shao through the use of a second molding step.

[496] For these reasons, a POSITA would have found the limitations in claim 1(c)(iii) to be obvious based on the Yamawaki-Shao combination.

d. an overmold surrounding the undermold and forming an undermold-overmold interface at an outer surface of the undermold.

[497] Yamawaki teaches applying an overmold over an undermold of a branch

cable connection to provide an added layer of waterproofing. *See* EX1006, 10:19-22; 13:15-18. In particular, Yamawaki discloses applying an overmold (i.e., covering member) over the undermold (i.e., molded underbody) covering a nexus (i.e., a branch junction) of cables (i.e., a feeder cable and a branch cable). *See id*. As shown in FIG. 9B (1st-annotation), below.



EX1006, FIG. 9B (1st-annotation)

[498] A POSITA considering Yamawaki and Shao would appreciate that these two disclosures describe methods for encasing cable junctions with insulating layers that can provide protection from the environment and other benefits discussed earlier with respect to Yamawaki (*see* 'F(i) Motivation to Combine Yamawaki and Shao' discussed above). A POSITA considering Yamawaki and Shao would have found it obvious to maintain the overmold taught by Yamawaki

when adopting the undermold design to by Shao in order to maintain the added protection against environmental elements (e.g., waterproofing) and provide a low profile branch junction that occupies less space, as taught by Shao (*see* 'F(i) Motivation to Combine Yamawaki and Shao' further discussed above).

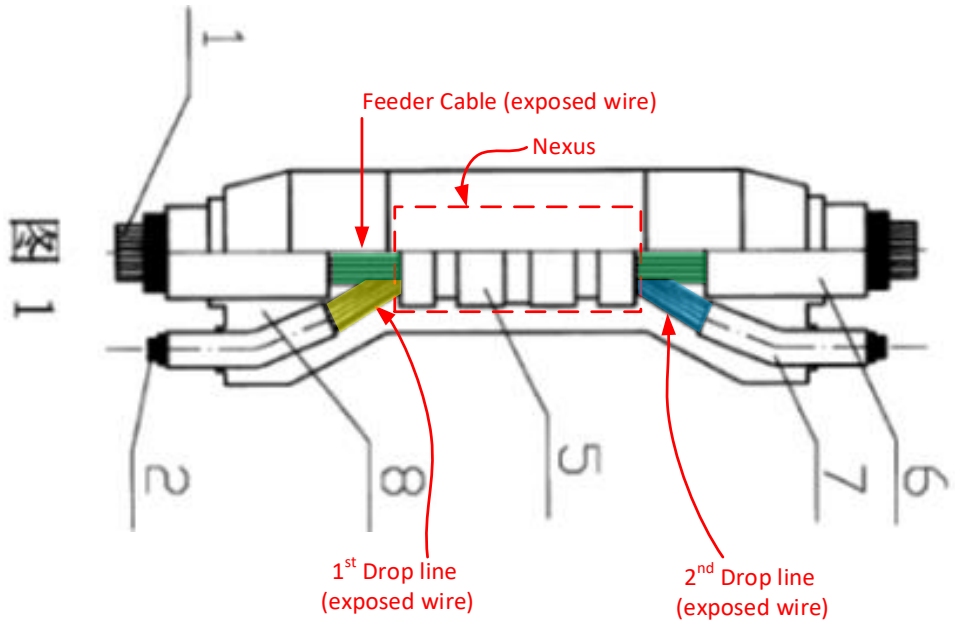
[499] In considering Yamawaki and Shao together, a POSITA would appreciate that Yamawaki discloses a variety of serial and parallel wiring assembly configurations allowing users to select combinations appropriate for their system configuration. *See* EX1006, FIGS. 3-6 and 13. Shao discloses a connection arrangement that can be used for joining the main cables and drop lines and providing insulation and molding to protect the junctions. Yamawaki provides further improvements to branch junctions that include a molded body (i.e., an undermold) covered by a cover member (i.e., an overmold). *See* EX1006, 10:19-22 and FIG. 9B. In addition, Yamawaki discloses that such branch junctions provide water-resistance and improved reliability. *See id*., 13:15-18. For these reasons, a POSITA would have found the claim 1(d) limitations to be obvious based on the Yamawaki-Shao combination.

[500] A POSITA would have found claim 1 to be obvious based on the Yamawaki-Shao combination. Accordingly, claim 1 should be found invalid under 35 U.S.C. § 103 based on Yamawaki and Shao.

2. Claim 2

The lead assembly of claim 1 wherein the drop line includes a section of exposed wire at the *nexus*.

[501] Shao discloses, and shows in an illustration reproduced below, that the drop line (i.e., branch-line conductors 2) includes a section of exposed wire (colored yellow in the annotation below) at the nexus. *See* EX1008, FIG. 1 (1st-annotation), below.



EX1008, FIG. 1 (1st-annotation)

[502] As a general observation, any cable junction that combines multiple cables must include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables. Therefore, it would be obvious to include a section of exposed wire for the feeder cable and the drop line at the location of the nexus. Nevertheless, Shao discloses the details of the

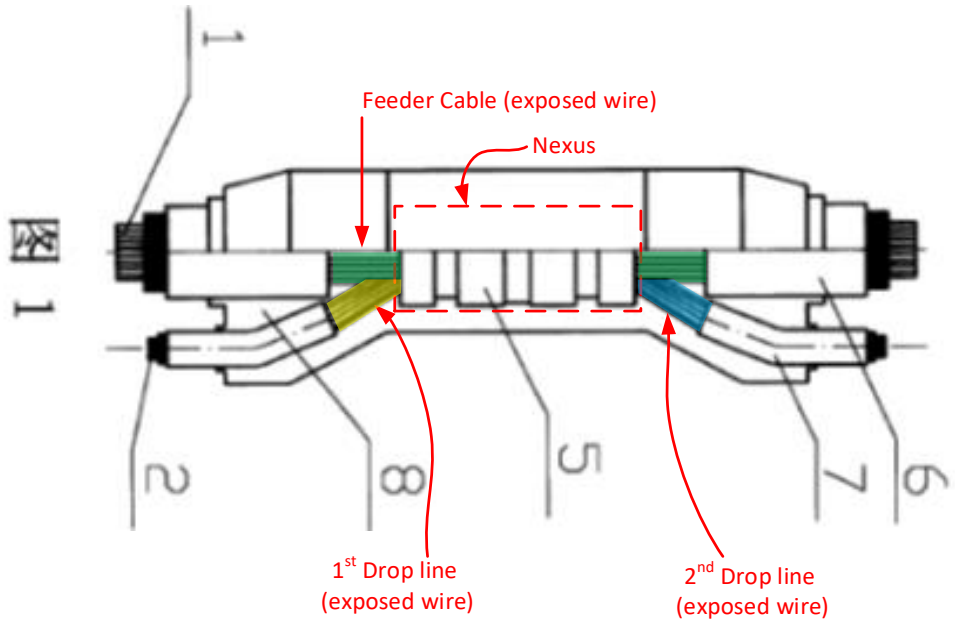
cable junction including the obvious need to remove insulation and provide exposed wire for the feeder cable and the drop lines at the nexus.

[503] For these reasons, a POSITA would have found the limitations in claim 2 to be obvious based on the Yamawaki-Shao combination.

3. Claim 3

The lead assembly of claim 2 wherein the feeder cable includes a section of exposed wire at the *nexus*.

[504] Shao discloses, and shows in an illustration reproduced below, that the feeder cable (i.e., trunk conductor 1) includes a section of exposed wire (colored green in the annotation below) at the nexus. *See* EX1008, FIG. 1 (1st-annotation), below.



EX1008, FIG. 1 (1st-annotation)

[505] As discussed above, any cable junction that combines multiple cables must

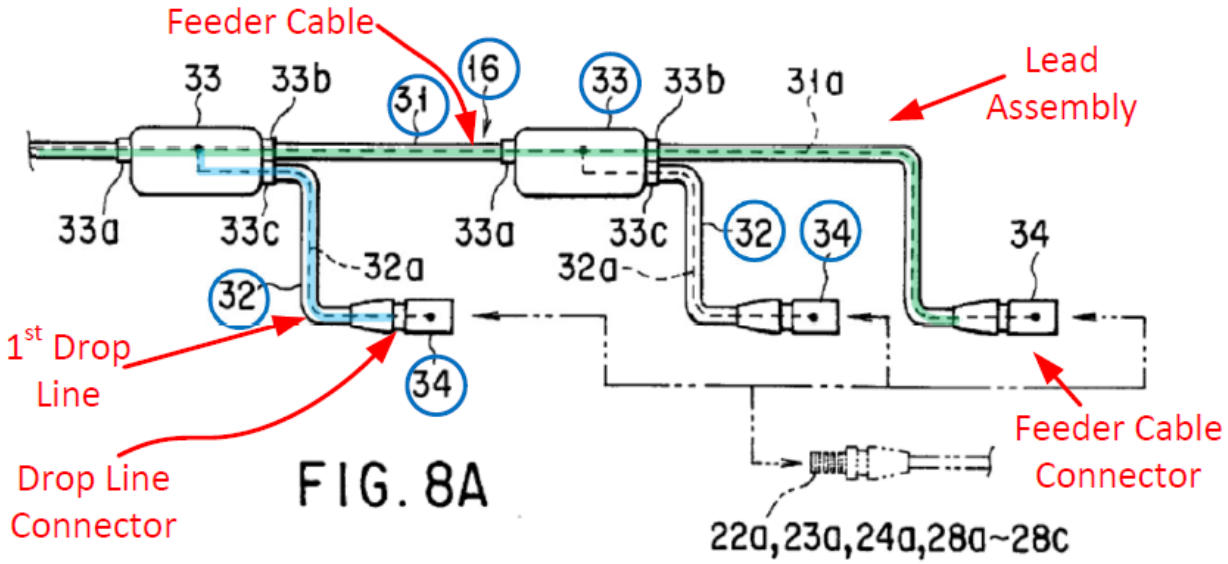
include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables.

[506] For these reasons, a POSITA would have found the limitations in claim 3 to be obvious based on the Yamawaki-Shao combination.

4. Claim 5

The lead assembly of claim 1, wherein the feeder cable terminates at a feeder cable connector.

[507] Yamawaki discloses, and shows in an illustration reproduced below, that the feeder cable (i.e., trunk cable 31 – annotated in green below) terminates at a feeder cable connector (i.e., connector 34). *See* EX1006, FIG. 8A (1st-annotation), below.



EX1006, FIG. 8A (1st-annotation)

[508] For these reasons, a POSITA would have found the limitations in claim 5 to be obvious based on the Yamawaki-Shao combination.

5. Claim 6

The lead assembly of claim 5, wherein the feeder cable connector is configured to attach directly to an inverter.

[509] I am informed by Counsel that the recitation of "the feeder cable connector is configured to attach directly to an inverter," is an intended use limitation since it recites a feature (i.e., the feeder cable connector) by what it does (i.e., attach directly to an inverter) rather than by what it is. Nonetheless, although the Yamawaki-Shao combination doesn't disclose the feeder cable connector attached directly to an inverter, this wiring configuration was well known to POSITAs. *See* EX1010, Fig. 690.1(B)(top diagram), p.544, reproduced below. For example, a POSITA would have been familiar with the NEC 2002 which illustrates in Figure 690.1(B)of a main feeder cable of a branching "photovoltaic source circuit" connected directly to an inverter. *See id*.

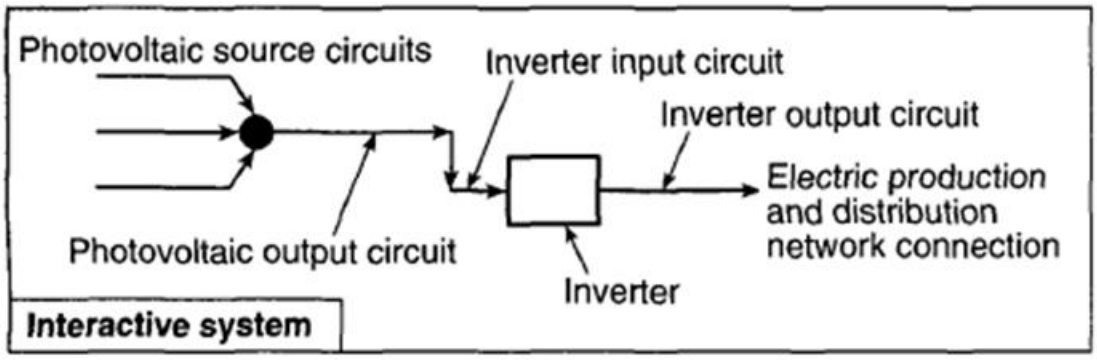


Figure 690.1(B) (top diagram)

[510] Further, a POSITA would have been motivated to attach a feeder cable directly to an inverter, particularly for installations in which the inverter is in

close proximity and can extend to be connected directly to feeder cable without the need for a jumper cable. *See* EX1010 p.544.

[511] As discussed above, a POSITA would further understand that the combiner box is one example of a convenient means for merging current from several lead assemblies to a single cable that is applied to the terminal of the inverter. Alternately, a POSITA would understand that the cable assemblies may be arranged so that all of the current from the solar panels in the installation are brought together through a series of junctions and or branch structures to a single cable that can be applied to the terminal of the inverter without need for a combiner box.

[512] For these reasons, a POSITA would have found the claim 6 limitations to be obvious based on the Yamawaki-Shao combination.

6. Claim 7

The lead assembly of claim 5, wherein the feeder cable connector is configured to attach directly to a jumper cable, which in turn connects directly to an inverter.

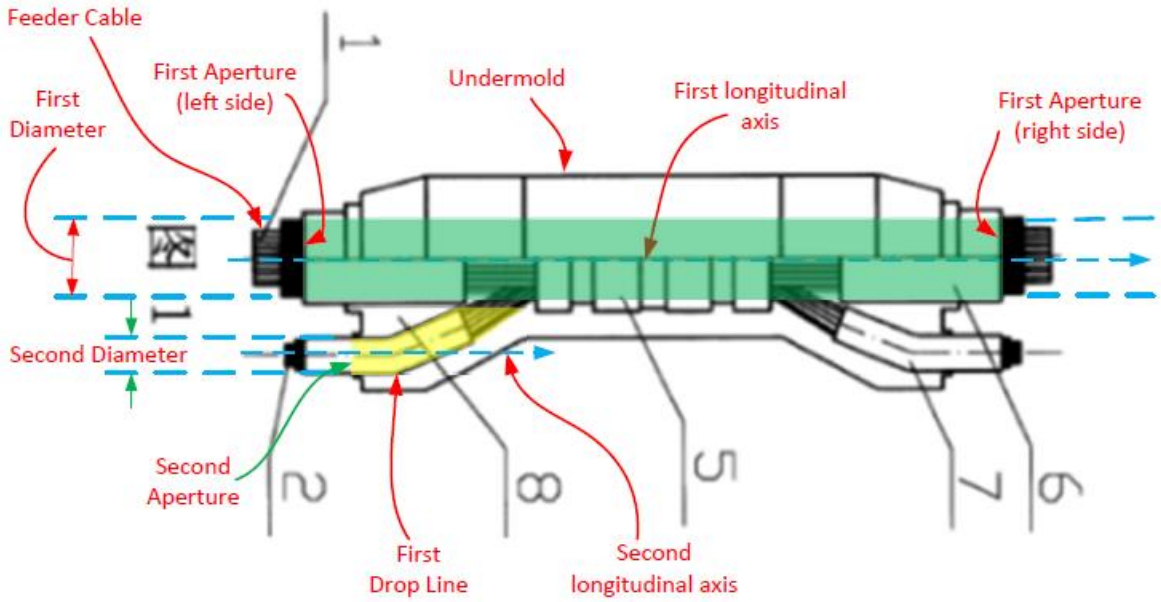
[513] Although the recitation that "the feeder cable connector [being] configured to attach directly to…," is an intended use limitation, as discussed above regarding Ground 2, claim 7, Yamawaki teaches that the feeder cable connector may be connected directly to a jumper cable, which in turn connects directly to an inverter unit 13. *See* EX1006, 7:45-8:11.

[514] For these reasons, a POSITA would have found the claim 7 limitations to be obvious based on the Yamawaki-Shao combination.

7. Claim 8

The lead assembly of claim 1, wherein the first longitudinal axis and the second longitudinal axis are substantially parallel.

[515] Shao discloses, and shows in an illustration reproduced below, that the first longitudinal axis (of the first aperture) and the second longitudinal axis (of the second aperture) are substantially parallel. *See* EX1008, FIG. 1 (3rd-annotation), below. This configuration of substantially parallel axis provides a compact configuration enabling branch wires to divide off from the feeder cable without having to bend, while maintaining a profile not much wider than the original feeder cable (e.g., smaller space occupied). *See id*. A POSITA would be motivated to use the undermold configuration, taught by Shao, to provide a low profile assembly that takes up less room within an installation.



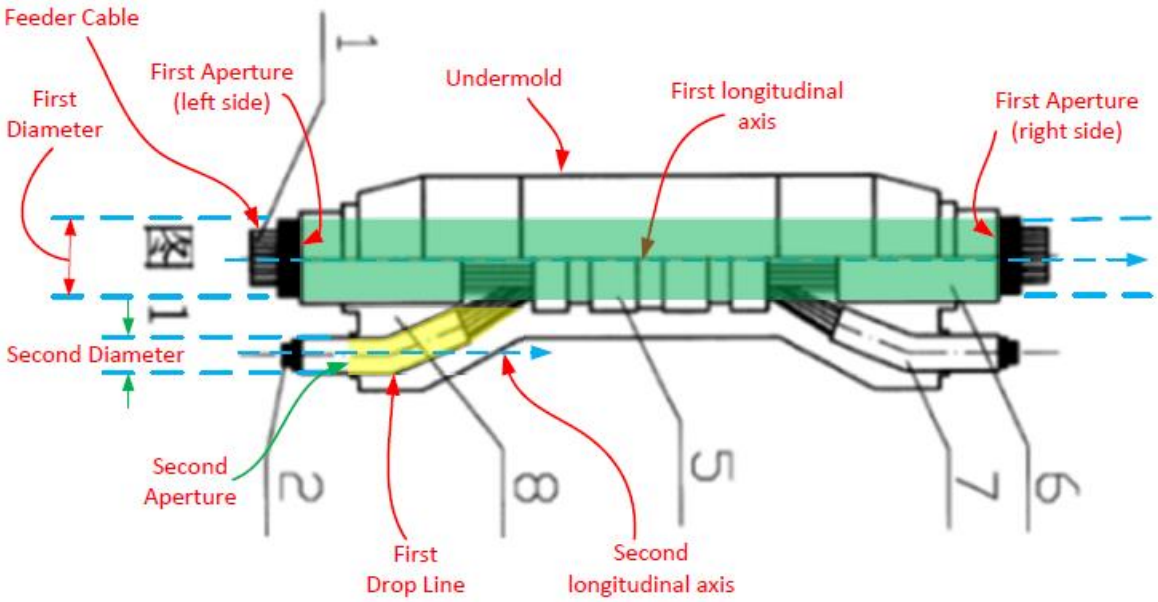
EX1008, FIG. 1 (3rd-annotation)

[516] For these reasons, a POSITA would have found the limitations in claim 8 to be obvious based on the Yamawaki-Shao combination.

8. Claim 9

The lead assembly of claim 1, wherein the second diameter is smaller than the first diameter.

[517] Shao discloses, and shows in an illustration reproduced below, that the second diameter (of the second aperture) is smaller than the first diameter (of the first aperture). *See* EX1008, FIG. 1 (3rd-annotation), below.



EX1008, FIG. 1 (3rd-annotation)

[518] A POSITA would understand that the drop lines bring current from individual solar array elements and merges this current with the other current already flowing from other elements in the feeder cable. Generally, drop lines carry much less current than feeder cables, and as a result can be smaller diameter cables that are lighter, easier to manipulate, and less expensive. A POSITA would use established electrical practices to select the cables for drop lines and feeder cables with diameters (or gauge) based on their design currents as specified in the NEC 2002 (EX1010). As a consequence, a POSITA would understand and consider it obvious that drop lines that carry less current could have smaller diameters than the higher-current carrying feeder cable, and therefore have a smaller diameter aperture within the connector than the aperture in the connector formed by the larger diameter feeder cable.

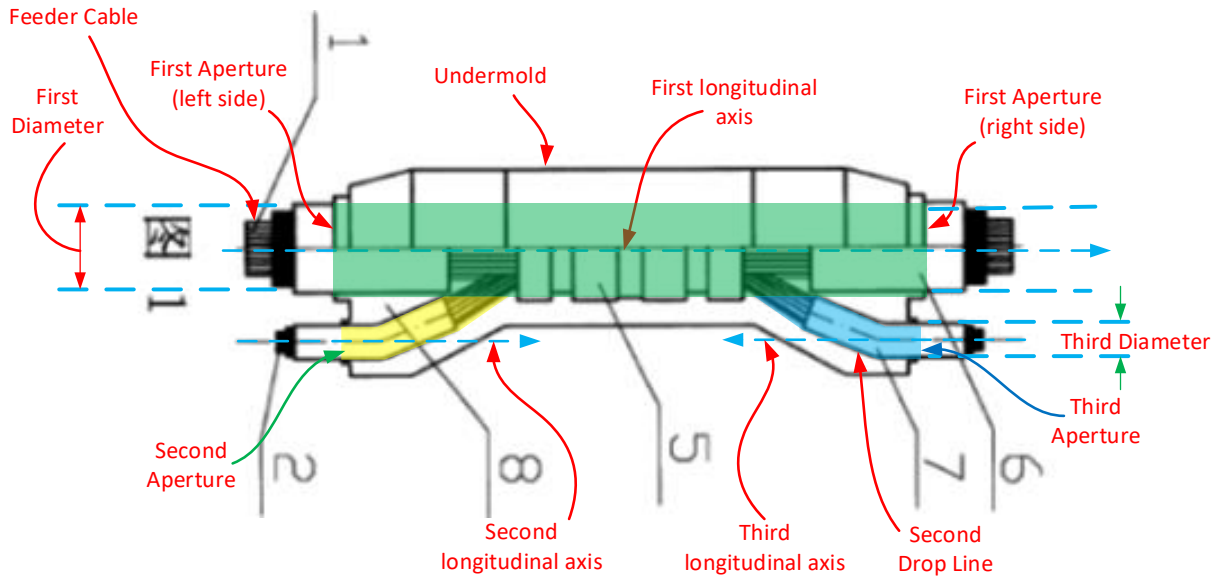
Therefore, a POSITA would find the claim language of the second diameter associated with the second aperture smaller than the first diameter associated with the first aperture to be obvious based on established electrical practices as well as the teachings in Shao (e.g., the dimensions visible in FIG. 1 of Shao reproduced above).

[519] For these reasons, a POSITA would have found the limitations in claim 8 to be obvious based on the Yamawaki-Shao combination.

9. Claim 10

The lead assembly of claim l, wherein the third longitudinal axis is substantially concentric with the second longitudinal axis, and substantially parallel with the first longitudinal axis.

[520] Shao discloses, and shows in an illustration reproduced below, that the third longitudinal axis is substantially concentric with the second longitudinal axis, and substantially parallel with the first longitudinal axis. *See* EX1008, FIG. 1 (5th-annotation), below.



EX1008, FIG. 1 (5th-annotation)

[521] As discussed in Shao, and would be understood by a POSITA, it is convenient for the drop lines to be arranged symmetrically and in parallel with the feeder cables in a solar installation, as this arrangement provides opportunities for cables to be routed in parallel and tied together so as to minimize the tangling and disorderly positioning of the cables in a large-scale installation. As discussed by Shao, "The branch lines no longer need to be bent and turned, so that one branch joint can be omitted, a space occupied for mounting is small, and a line can also be simple and clear. "

[522] For these reasons, a POSITA would have found the limitations in claim 10 to be obvious based on the Yamawaki-Shao combination.

10. Claim 12

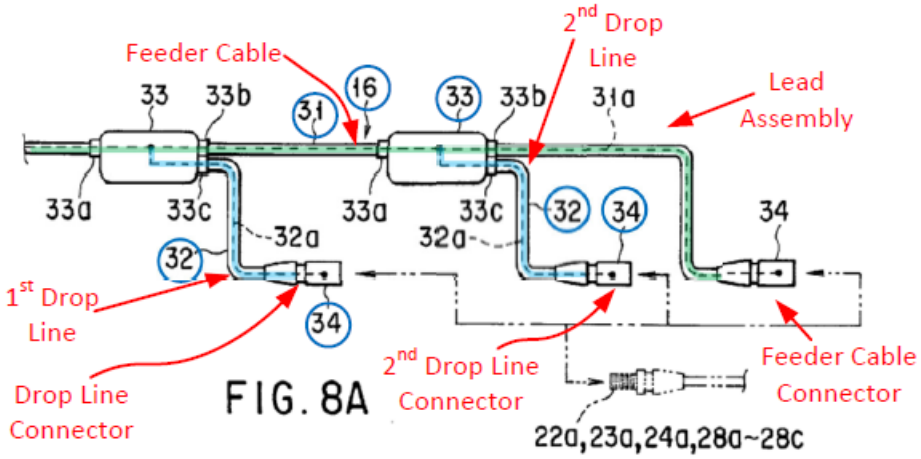
The lead assembly of claim 1, wherein said lead assembly combines power received from the plurality of solar panels and conducts that power directly to an inverter electrically connected to the feeder cable.

[523] The claim 12 limitations are the same as or at least equivalent to the claim elements 1(a) and 1(b), and claim 7 limitations addressed above. For the reasons presented above regarding the claim elements 1(a) and 1(b), and claim 7 limitations, which I incorporate here by reference, a POSITA would have found the claim 12 limitations to be obvious based on Yamawaki and Shao.

11. Claim 13

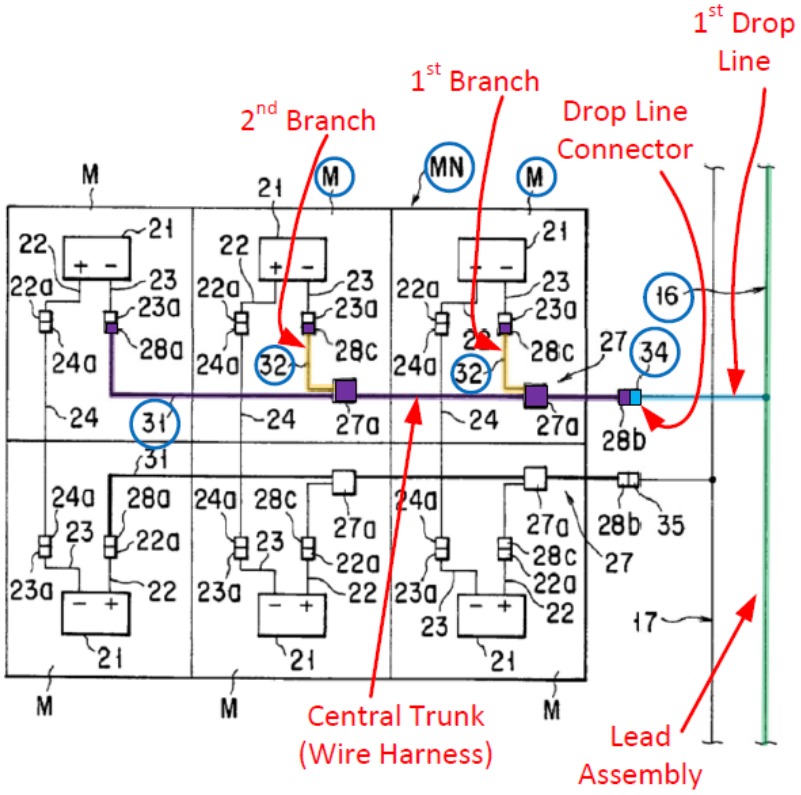
The lead assembly of claim 1, wherein the second drop line terminates at a second drop line connector, the second drop line connector configured to connect with a central trunk of a second wire harness, the central trunk of the second wire harness having a plurality of branches the each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of solar panels.

[524] Yamawaki discloses, and shows in an illustration reproduced below, first and second drop lines (i.e., branch cables 32) each terminating at a drop line connector (i.e., connector 34). *See* EX1006, 11:3-7 and FIG. 8A (2nd-annotation), reproduced below.



EX1006, FIG. 8A (2nd-annotation)

[525] Also, Yamawaki discloses that the first drop line (i.e., left side branch cable 32, above) and the second drop line (i.e., right side branch cable 32, above) are each configured to connect, via the drop line connectors (34) to separate wire harnesses that connect to separate solar panel arrays. *See id.*, 8:49-58; FIG. 8A (2nd-annotation), above and FIG. 7 (1st-annotation), below. In FIG. 7, annotated and reproduced below, Yamawaki discloses and illustrates that each drop line connector (i.e., connector 34) of the lead assembly (i.e., wiring apparatus 16) is connected to a central trunk (trunk cable 31) of a wire harness. *See id.*, FIG. 7 (1st-annotation), below.



EX1006, FIG. 7 (1st-annotation)

[526] The various diagrams provided by Yamawaki enable a designer to design a cable harness system appropriate to match the solar array installation. In a case where the design includes a second wire harness associated with a second set of solar cells, a POSITA would understand that it is possible to configure elements, such as those shown in the illustration, along with other elements so as to enable a second drop line that terminates at a second drop line connector, where the second drop line connector is configured to connect with a central trunk of a second wire harness, and where the central trunk of the second wire harness has a plurality of branches where each are configured to electrically connect to a separate solar panel contained in a second array of a plurality of

solar panels. Yamawaki provides flexible building blocks (cables, junctions, connectors, etc.) that are designed to allow assembly into many different configurations. A POSITA would appreciate that the examples explicitly shown in Yamawaki are representative, and not intended to be the only possible combination of components or combination of components from Yamawaki.

[527] By combining Shao and Yamawaki, a POSITA would preserve the range of overall system designs enabled by Yamawaki, which provide the improved reliability and performance that is associated with the detailed junction design and undermold/overmold designs disclosed in Shao. For example, by incorporating the undermold (connector outer sheath 8) taught by Shao into the lead assembly (wiring apparatus 16, 17) disclosed by Yamawaki, the two drop lines (branch cables 32) would branch from the same nexus for providing a more compact and efficient configuration. *See* EX1008, 5:27-30.

[528] For these reasons, a POSITA would have found the limitations in claim 13 to be obvious based on the Yamawaki-Shao combination.

12. Claim 14

The lead assembly of claim 13, wherein the lead assembly is configured to combine electrical power received from the array of solar panels and the second array of solar panels at the *nexus* and to deliver the combined electrical power to an inverter that is in electrical communication with the feeder cable.

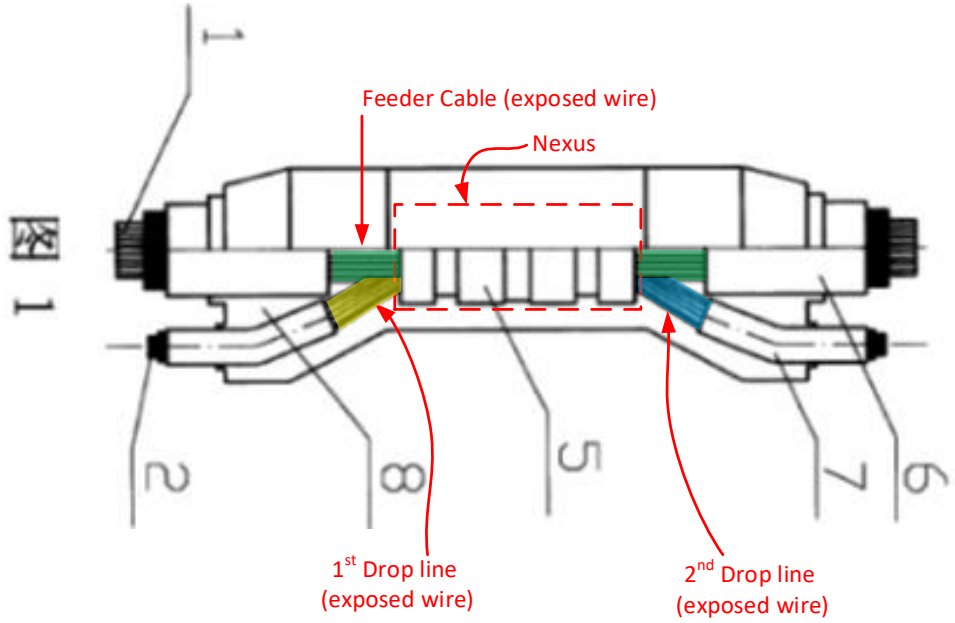
[529] The claim 14 limitations are the same as or at least equivalent to the claims 7, 12, and 13 limitations addressed above. For the reasons presented above

regarding the claims 7, 12, and 13 limitations, which I incorporate here by reference, a POSITA would have found the claim 14 limitations to be obvious based on Yamawaki and Shao.

13. Claim 15

The lead assembly of claim 1, wherein the second drop line includes a section of exposed wire at the nexus so as to be electrically connected to the feeder cable.

[530] Shao discloses, and shows in an illustration reproduced below, that the second drop line includes a section of exposed wire (colored blue in the annotation below) at the nexus so as to be electrically connected to the feeder cable (colored green in the annotation below). *See* EX1008, FIG. 1 (1st-annotation), below.



EX1008, FIG. 1 (1st-annotation)

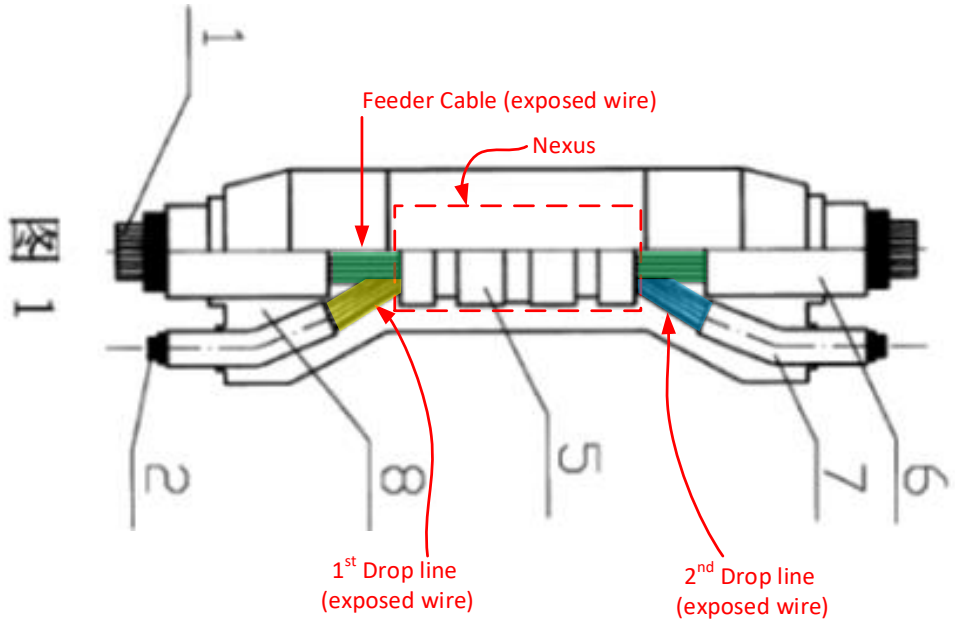
[531] As discussed above with regard to claims 2 and 3, any cable junction that combines multiple cables must include a process for removing the original cable insulation from the cables to be joined at the point of joining the cables.

[532] For these reasons, a POSITA would have found the limitations in claim 15 to be obvious based on the Yamawaki-Shao combination.

14. Claim 18

The lead assembly of claim 15, wherein the electrical coupling between the feeder cable, the drop line and the second drop line at the nexus is secured with at least one of a compression lug, a solder connection, a splice, and a crimp.

[533] Shao discloses, and shows in an illustration reproduced below, that "an elongated copper C-shaped clamp is used to form a K-shaped branch connector 5," which maintains an engagement between the feeder cable and the drops lines at the nexus. EX1008, p.6:17-18 and EX1008, FIG. 1 (1st-annotation), below. As explained above, a POSITA would recognize that a C-shaped clamp used to make an electrical connection as described in Shao is equivalent to a "crimp."



EX1008, FIG. 1 (1st-annotation)

[534] As described by Shao, "The K-shaped branch connector is an elongated C-shaped clamp made of a copper material. The joint is formed by symmetrical overlapping and crimping of one trunk conductor and two branch-line conductors." EX1008, 5:10-13. Therefore, Shao discloses the use of crimping to form the nexus.

[535] For these reasons, a POSITA would have found the limitations in claim 18 to be obvious based on the Yamawaki-Shao combination.

15. Claim 19

The lead assembly of claim 1, wherein the undermold is applied by injection molding.

[536] Although Yamawaki discloses that the undermold (i.e., the molded body 33e) is "molded," Yamawaki does not explicitly disclose that the undermold in

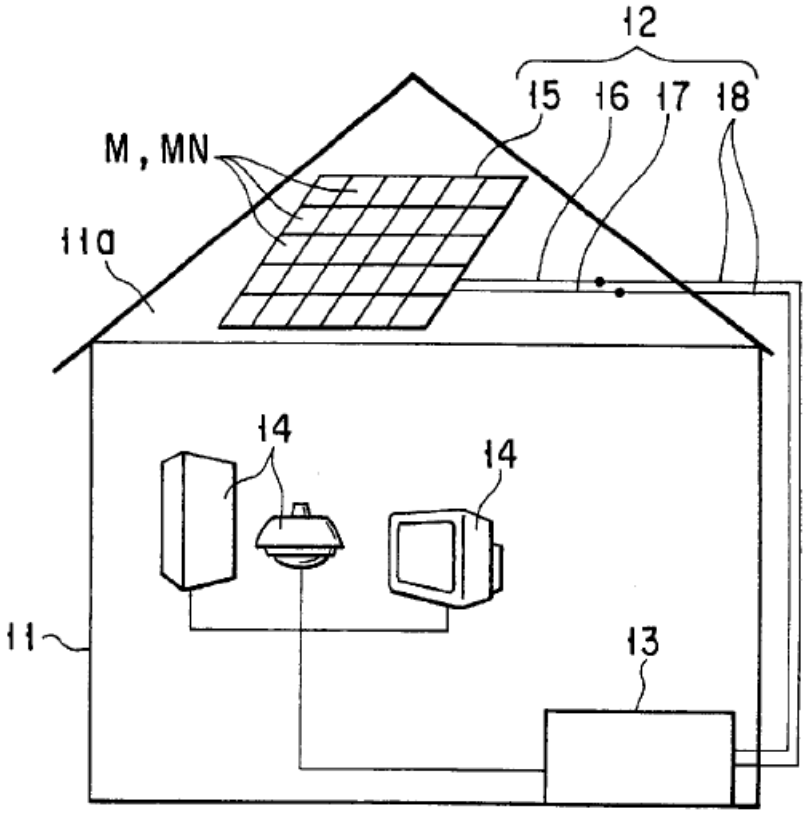
injection molded. *See* EX1006, 10:19-22. Nonetheless, Shao discloses a feeder cable's electrical coupling to drop lines at a nexus that is covered by a sheath made of injection molding material, which is an undermold that fully encases the nexus. *See* EX1008, 5:15-20. A POSITA would recognize that an injection molded sheath (i.e., an undermold), as taught by Shao, encases the exposed cables and the metal clamp holding them together is better protected from damage and/or exposure (*see* 'F(i) Motivation to Combine Yamawaki and Shao' further discussed above).

[537] For these reasons, a POSITA would have found the limitations in claim 19 to be obvious based on the Yamawaki-Shao combination.

16. Claim 21

Preamble. A solar power system comprising:

[538] Yamawaki discloses a solar power system (i.e., a photovoltaic generation system). *See* EX1006, 3:9-11 and FIG. 1, below.



EX1006, FIG. 1

[539] For these reasons, a POSITA would have found the limitations in claim 21(Preamble) to be obvious based on Yamawaki.

a. a plurality of solar panels each electrically coupled to one of a plurality of branches of a wire harness to form a first solar array;

[540] The claim 21(a) limitations are the same as or at least equivalent to the claim 1(a) limitations addressed above. For the reasons presented above regarding the claim 1(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(a) limitations to be obvious in view of Yamawaki.

[541] For these reasons, a POSITA would have found the limitations in claim 21(a) to be obvious based on Yamawaki.

b. a lead assembly comprising:

[542] The claim 21(b) limitations are the same as or at least equivalent to the claim 1(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b) limitations to be obvious based on Yamawaki.

i. a drop line electrically connected to a central trunk of the wire harness and configured to receive power from the plurality of solar panels;

[543] As discussed above with regard to the claim 1(a) limitations, Yamawaki discloses that the drop line connector is connected to a central trunk of a wire harness, and the central trunk of the wire harness inherently has a plurality of branches that each electrically connect to separate solar panels that together are a part of an array of a plurality of solar panels. For the reasons presented above regarding the claim 1(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(i) limitations to be obvious based on Yamawaki.

ii. a second drop line electrically connected to a central trunk of a second wire harness and configured to receive power from a plurality of solar panels in a second solar array;

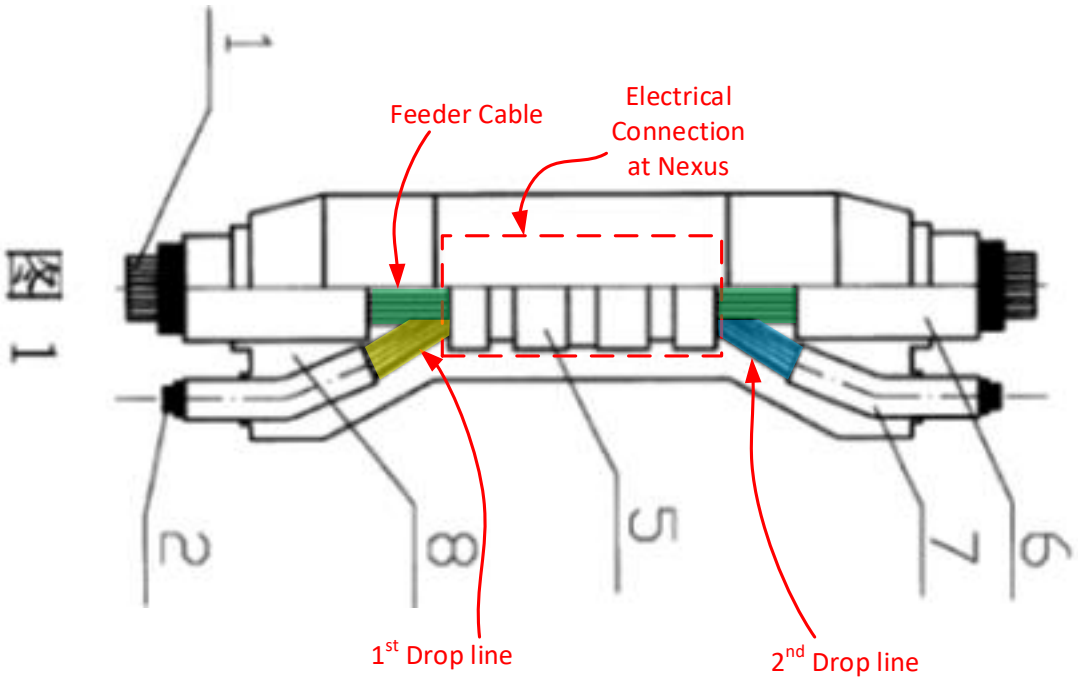
[544] As discussed above with regard to the claim elements 1(c)(iii) and claim 13 limitations, the Yamawaki-Shao combination discloses a second drop line electrically connected to a central trunk of a second wire harness and

configured to receive power from a plurality of solar panels in a second solar array. For the reasons presented above regarding the claim elements 1(c)(iii) and claim 13 limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(ii) limitations to be obvious based on the Yamawaki-Shao combination.

iii. a feeder cable, the feeder cable electrically connected to the drop line and the second drop line at a nexus; and

[545] As discussed above with regard to the limitations of claim elements 1(b) and 1(c)(iii) and claim 18, Yamawaki discloses a feeder cable electrically connected to the drop line and the second drop line at a nexus. See my full explanation of the relevant disclosures of the Yamawaki-Shao combination in the discussion of the claim elements 1(b) and 1(c)(iii) and claim 18 limitations, which I incorporate here by reference.

[546] In particular, Shao discloses a feeder cable electrically connected to the drop line and the second drop line at a nexus. *See* EX1008, FIG. 1 (6th-annotation), below.



EX1008, FIG. 1 (6th-annotation)

[547] For these reasons, a POSITA would have found the limitations in claim 21(b)(iii) to be obvious based on the Yamawaki-Shao combination.

iv. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[548] The specification of the '153 Patent does not define the term "primary mold" or detail about how the primary mold "substantially seals" the nexus because no description of a sealing function of the primary mold or undermold was included in the original disclosure. *See* EX1001, generally. Based on illustrations in the '153 Patent and the plain and ordinary meaning of the expression "primary mold" in the context of the claim, it is my opinion that a POSITA would have understood the term "primary mold" in the '153 Patent

claims to mean a " material molded over a piece or part that seals against environmental factors." *See* EX1001, FIGS. 48, 54, 55, 60 and generally. This definition is consistent with a definition adopted by the Order in the parallel proceedings before the International Trade Commission involving the '153 Patent. *See* EX1017, p.36. That construction is informative for establishing how a POSITA would understand the terms in the context of the '153 Patent claims.

[549] Thus, the claim 21(b)(iv) limitations are the same as or at least equivalent to the claim element 1(c) and claim 18 limitations addressed in Ground 2. For the reasons presented in Ground 2 for the claim element 1(c) and claim 18 limitations, which I incorporate here by reference, a POSITA would have found the claim 21(b)(iv) limitations to be obvious based on the Yamawaki-Shao combination.

> **(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture;**
>
> **(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture and**
>
> **(3) a third aperture extending partially through the primary mold and having a third diameter smaller than the first diameter, wherein the second drop line extends into the third aperture.**

[550] The claim 21(b)(iv)(1-3) limitations are the same as or at least equivalent to

the claim 1(c)(i)-(iii) limitations addressed above in this Ground 5. For the reasons presented for the claim 1(c)(i)-(iii) limitations, which I incorporate here by reference. Although the claim elements 21(b)(iv)(2) and 21(b)(iv)(3) refer to "smaller" diameters, in contrast to claim elements 1(c)(ii) and 1(c)(iii), which refer to "different" diameters, reciting that two apertures have different diameters implies a comparison where one aperture must necessarily have a smaller diameter than the other. For these reasons and the ones presented regarding the claim 1(c)(i)-(iii) limitations, a POSITA would have found the claim 21(b)(iv)(1-3) limitations to be obvious based on the Yamawaki-Shao combination. Therefore, claim 21 is obvious based on the Yamawaki-Shao combination.

17. Claim 22

The solar power system of claim 21, wherein the feeder cable is directly electrically connected to a component selected from the group consisting of a trunk buss jumper, an inverter, a connection unit, a recombiner, and a disconnect unit.

[551] The claim 22 limitations are the same as or at least equivalent to the claim 6, claim 12, and claim 14 limitations addressed above. For the reasons presented above regarding the claim 6, claim 12, and claim 14 limitations, which I incorporate here by reference, a POSITA would have found the claim 22 limitations to be obvious based on Yamawaki and Shao.

18. Claim 23

The solar power system of claim 21, further comprising a secondary mold surrounding the primary mold and forming an undermold-overmold interface at an outer surface of the primary mold.

[552] The claim 23 limitations are the same as or at least equivalent to the claim 1(d) limitations addressed above in this Ground 5. For the reasons presented above for the claim 1(d) limitations, which I incorporate here by reference, a POSITA would have found the claim 23 limitations to be obvious based on the Yamawaki-Shao combination.

19. Claim 24

Preamble. A solar power system comprising:

[553] The claim 24(Preamble) limitations are the same as or at least equivalent to the claim 1(Preamble) or claim 21(Preamble) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) or claim 21(Preamble) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(Preamble) limitations to be obvious based on Yamawaki.

a. a plurality of solar panels electrically coupled by a wire harness to form a first solar array;

[554] The claim 24(a) limitations are the same as or at least equivalent to the claim 21(a) limitations addressed above. For the reasons presented above regarding the claim 21(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(a) limitations to be obvious based on

Yamawaki.

b. a lead assembly comprising:

[555] The claim 24(b) limitations are the same as or at least equivalent to the claim 1(Preamble) or claim 21(b) limitations addressed above. For the reasons presented above regarding the claim 1(Preamble) and/or claim 21(b) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b) limitations to be obvious based on Yamawaki.

i. a first drop line electrically connected to the wire harness and configured to receive power from the plurality of solar panels;

[556] The claim 24(b)(i) limitations are the same as or at least equivalent to the claim element 1(a) limitations addressed above. For the reasons presented above regarding the claim element 1(a) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(i) limitations to be obvious based on Yamawaki.

ii. a feeder cable, the feeder cable electrically connected to the drop line at a nexus;

[557] The claim 24(b)(ii) limitations are the same as or at least equivalent to the claim element 1(b) limitations addressed above. For the reasons presented above regarding the claim element 1(b) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(ii) limitations to be obvious based on Yamawaki.

iii. a primary mold that fully encases the nexus so as to substantially seal the nexus from external environmental conditions, the primary mold further comprising:

[558] The claim 24(b)(iii) limitations are the same as or at least equivalent to the claim element 1(c) or claim 18 limitations addressed above. For the reasons presented above regarding the claim element 1(c) or claim 18 limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iii) limitations to be obvious based on the Yamawaki-Shao combination.

(1) a first aperture extending completely through the primary mold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis;

[559] The claim 24(b)(iii)(1) limitations are the same as or at least equivalent to the claim element 1(c)(i) limitations addressed above. For the reasons presented above regarding the claim 1(c)(i) or claim 21(b)(iv)(1) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iii)(1) limitations to be obvious based on the Yamawaki-Shao combination.

(2) a second aperture extending partially through the primary mold and having a second diameter smaller than the first diameter, wherein the drop line extends into the second aperture along a second longitudinal axis; and

[560] The claim 24(b)(iii)(2) limitations are the same as or at least equivalent to the claim element 1(c)(ii) limitations addressed above. For the reasons presented above regarding the element claim 1(c)(ii) limitations, which I

incorporate here by reference, a POSITA would have found the claim 24(b)(iii)(2) limitations to be obvious based on the Yamawaki-Shao combination.

iv. a second drop line electrically connected to a second wire harness that connects to a plurality of solar panels, the second drop line electrically connected to the feeder cable at the nexus fully encased by the primary mold, wherein the second drop line extends into a third aperture defined by the primary mold along a third axis.

[561] The claim 24(b)(iv) limitations are the same as or at least equivalent to the claim element 1(c)(iii) limitations addressed above. For the reasons presented above regarding the claim element 1(c)(iii) limitations, which I incorporate here by reference, a POSITA would have found the claim 24(b)(iv) limitations to be obvious in view of Yamawaki as modified by Shao.

[562] In sum, for all of the reasons discussed above regarding Ground 5, it is my opinion that a POSITA would have found claims 1-3, 5-10, 12-15, 18, 19, and 21-24 to be obvious in view of Yamawaki and Shao, and therefore should be found invalid under 35 U.S.C. § 103 based on the Yamawaki-Shao combination.

F. Ground 6: Claims 11, 16, and 17 are unpatentable under 35 U.S.C. § 103 as obvious in view of Yamawaki, Shao, and Solon741.

(i) Motivation To Combine Yamawaki, Shao, and Solon741

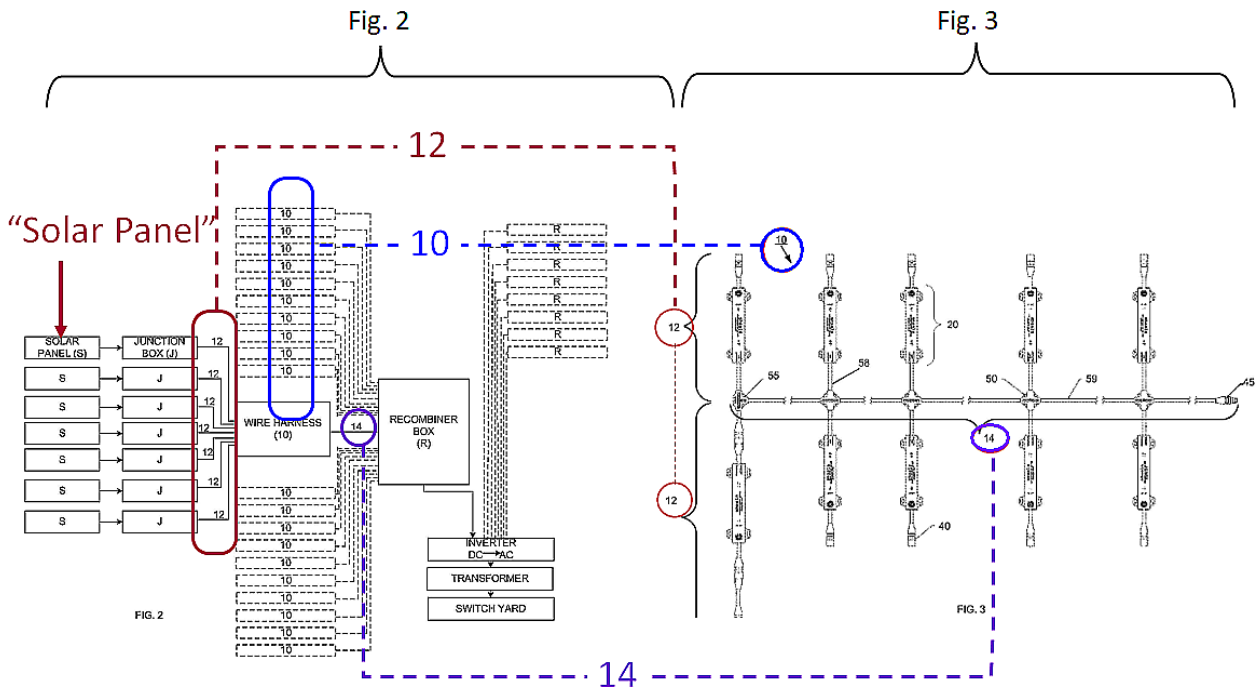
[563] A POSITA would have been motivated to combine the teachings of

Yamawaki and Shao with those of Solon741 (i.e., the "Yamawaki-Shao-Solon741 combination") for the reasons set forth below.

[564] As noted above regarding Ground 5, the Yamawaki-Shao combination discloses that wire harness and lead assembly designs disclosed by Yamawaki would benefit from the features disclosed by Shao, as related to the design and manufacture of the K-shaped branch structure shown in FIG. 1 from Shao, which provide "good insulation performance, heat resistance stability and overheating aging performance." *See* EX1008., 6:40-7:1.

[565] The Yamawaki-Shao combination does not explicitly teach drop lines that include a fuse, a particular wire gauge for the drop lines, or a particular wire size for the feeder cable. Solon741 together with ordinary design choices known to a POSITA would fill this deficit, as discussed below.

[566] Solon741 discloses a "Solar Energy Wire Harness with In-Line Fuses." EX1005, Abstract. Solon741 is analogous prior-art to the '153 Patent because it is directed to solar power lead assemblies with in-line fuses. *See id.*, Title. Solon741 "relates generally to components used in the solar energy industry" and focuses on wire harnesses for solar applications. EX1005, ¶2. The combined figures below, reproduced from Solon741, show a typical solar power system array. *See* EX1005, FIGS. 2 and 3 (combined with 2nd-annotation).



EX1005, FIGS. 2 and 3 (combined with 2nd-annotation)

[567] Solon741 also adds the element of inline fuse holders. In particular, Solon741 discloses that, "[t]he in-line fuse assembly may include a variety of fuse types, such as midget fuses and/or 1000-V fuses. Further, Solon741 anticipates the need to protect each fuse from ambient conditions (i.e., the outdoor environment). *See id.*, ¶13. Of particular note is the current range disclosed in Solon741, namely "an ampacity of 2 to 30 amps" *Id.*, ¶32. Similarly, Solon741 discloses fuse voltage ranges of 500 – 1500 V and 600 – 1000V. *Id.*, ¶30.

[568] Likewise, the '153 Patent claims relate not only to lead assemblies in solar energy installations but also to in-line fuses for those lead assemblies. (EX1001, 4:51-55 and FIG. 5). Therefore, Solon741 is analogous prior-art to the '153

Patent, as well as Yamawaki and Shao.

[569] A POSITA would have been motivated to combine Yamawaki, Shao, and Solon741 (i.e., the "Yamawaki-Shao-Solon741 combination") because all three references discuss the design of cable junction elements that can be used to combine or distribute electrical power that is convenient, reliable, flexible, and low-cost. All three of these references disclose details of the construction of the cable junctions, including common elements that include crimping of the electrical wires and molding to form protective layers. A POSITA would look to this group of three references for details that can be combined to provide complimentary and additive benefits. In particular, Yamawaki discloses photovoltaic modules that may be arranged in various ways to overcome challenges and support the design of a photovoltaic panel array, such as on a home solar energy installation, in addition to improvements to branch junctions that include a molded body (i.e., an undermold) covered by a cover member (i.e., an overmold). *See* EX1006, 7:54-8:11, 10:19-22 and FIG. 9B. Shao discloses designs and manufacturing methods that can be used for joining the main cables and drop lines and providing insulation and molding to protect the junctions. *See* EX1008, 5:31-34, 6:18-30, and 6:40-7:1. Likewise, Solon741 is generally directed to solar energy wire harnesses that include in-line fuse assemblies. *See* EX1009, Abstract. The disclosure of Tamura is in the same

field of electrical connectors as Yamawaki and Shao, and is thus analogous prior art, and discloses a "Cable branch molding method." EX1009, ¶3. Tamura also discloses a double-molded structure that provides improved protection from water. *See* EX1009, ¶17. Accordingly, all four references are in the same field of endeavor. Further, Tamura addresses some of the same problems as the '153 Patent, such as the ability "for a plurality of solar arrays are electrically coupled together," and "arranging multiple solar battery modules comprising a plurality of solar 5 battery cells on a roof or on top of a building, and connecting the solar battery modules by means of cables." EX1009, ¶2.

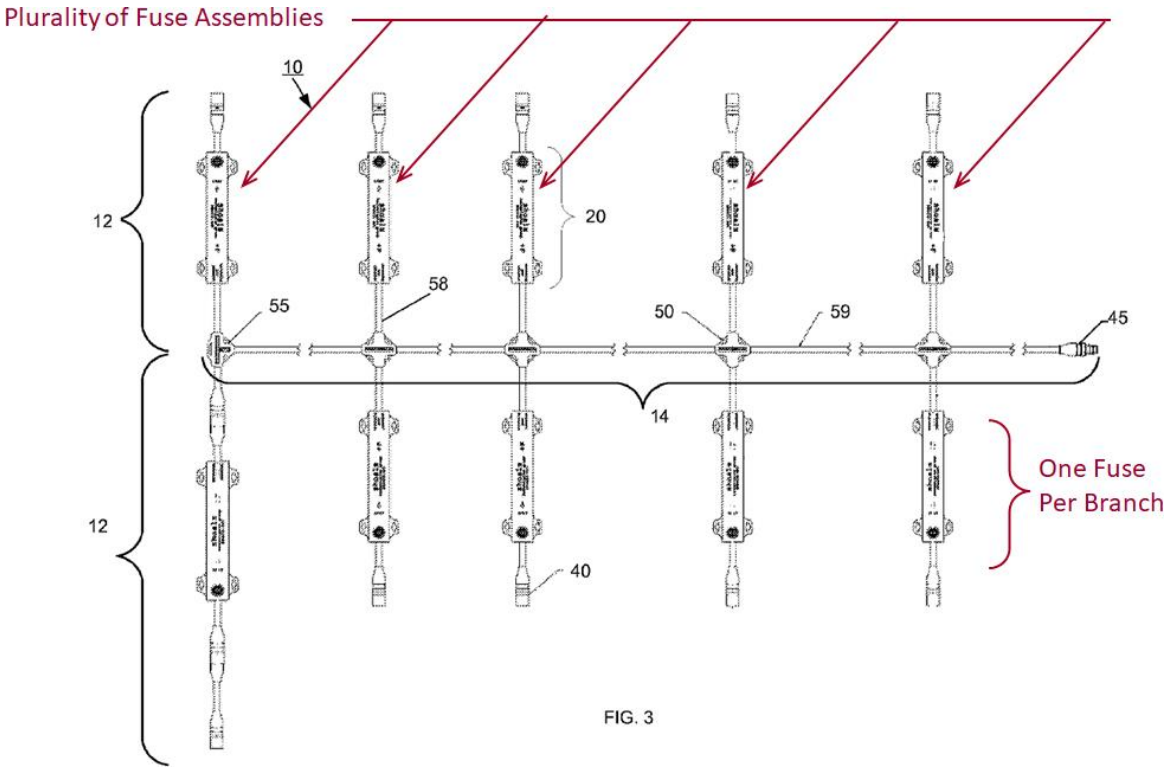
[570] It is my opinion that a POSITA would have had an expectation of success in combining the teachings of Yamawaki and Shao with that of Solon741, because teachings regarding solar power systems, lead assemblies, and branch connectors in Yamawaki and Shao are both complimented by the solar panel wiring harness with in-line fuse disclosed by Solon741. *See* generally EX1005. Whereas Yamawaki and Shao are concerned with power combining or power distribution, Solon741 provides a complete description of the design and construction of a solar energy wiring harness with the in-line fuses, which incorporates cable junctions along with in-line fuses and other elements of a complete solar energy installation. A POSITA would appreciate that the

disclosures of Yamawaki and Shao provide details about the cable junctions and other elements that could be applied to the more complete solar installation described by Solon741 and would consider using the details disclosed in Yamawaki and Shao in order to obtain the complimentary and additive benefits provided by all of these disclosures. In particular, the benefits of the undermold of Shao include "improved reliability", prolonged "service life", with "good sealing performance", and the benefits of the overmold of Yamawaki include "…it is so water resistant that the reliability of the wiring apparatus 16 and 17 to resist penetration of water can be improved." *See* EX1008, Abstract; EX1006, 13:16-18. A POSITA would understand that the combination of the undermold of Shao and the overmold of Yamawaki would provide complimentary and additive benefits that would be important in the system of Solon741, and that the sum of the benefits of the individual molds would lead to an improved product.

1. Claim 11

(i) The lead assembly of claim 1, wherein the drop line includes a fuse.

[571] Solon741 discloses, and shows in an illustration reproduced below, that the drop lines (branches 12 of the wire harness 10) each include one in-line fuse assembly 20, so wire harness 10 includes a plurality of in-line fuse assemblies 20 connected to branch wire 58, which is preferably photovoltaic wire. EX1005, ¶30 and FIG. 3 (1st -annotation), below.



EX1005, FIG. 3 (2nd-annotation)

For these reasons, a POSITA would have found the limitations in claim 11 to be obvious based on the Yamawaki-Shao-Solon741 combination.

2. Claim 16

The lead assembly of claim 1, wherein the drop line and the second drop line each includes a wire of between four (4) to eighteen (18) gauge.

[572] Solon741 discloses that the drop lines (i.e., branches 12) may be constructed of 10 or 12 gauge photovoltaic wire, which a POSITA would understand to include a wire between four and eighteen gauge. *See* EX1005, ¶29. A POSITA would understand that an appropriate drop line gauge should be selected for the intended use. In particular, a POSITA would understand that the maximum amount of current to be carried by a cable is an important parameter in selection

of the cable diameter and other cable parameters, such as the cable material and the insulation material. In particular, the NEC 2002 (EX1010) provides well-known guidelines for cable diameter selection for different amounts of maximum current. For example, NEC 2002 includes Table 310.16, titled "Allowable Ampacities of Insulated Conductors Rated 0 Through 2000 Volts…" which is reproduced below. *See* EX1010, p. 149. This table is a wire ampacity size table with which any POSITA would be familiar and provides a guide for the appropriate gauge wire for different ampacities of insulated conductors. *See id*. As shown in the table, wire gauges between 18 AWG and 4 AWG are expected to carry current from 14A to 95A at temperatures up to 90°C, and up to 70A at temperatures up to 60°C. *See id*. A POSITA would understand how to use the NEC 2002 and other guides to make decisions about the gauge of cable to use for different sections of a solar installation. Similar tables are provided in the NEC 2002 and other guides with information on selection for different voltages, and for resistances.

Size AWG or kcmil	Temperature Rating of Conductor (See Table 310.13.)						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18	—	—	14	—	—	—	—
16	—	—	18	—	—	—	—
14*	20	20	25	—	—	—	—
12*	25	25	30	20	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	190	230	255	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000

EX1010, Table 310.16

[573] For these reasons, a POSITA would have found the claim 16 limitations to be obvious based on the Yamawaki-Shao-Solon741 combination.

3. Claim 17

The lead assembly of claim 16, wherein the feeder cable includes a wire of between 250 MCM to 1000 MCM.

[574] A POSITA would understand that the abbreviation "MCM" stands for thousands of circular mils, which defines wire sizes. A typical 250 MCM cable would have a diameter of more than 1cm, and a 1000 MCM cable would have a

diameter near 2.5 cm. A POSITA would understand that an appropriate feeder cable gauge should be selected for the intended use. As noted above regarding claim 16, a POSITA would have used well-known practices and information (e.g., Table 310.16) provided in the NEC 2002 to identify appropriate cable diameters and other cable parameters, such as the cable material and the insulation material.

[575] The table 310.16 (reproduced above regarding Claim 16) includes ampacity values for cables with 250 or 1000 MCM diameter; these are expected to carry current from 215A to 455A. Other than diameter and current carrying capacity, there are no differences between cables from 18 AWG to 1000MCM. A POSITA would understand how to find and use practice guides including the NEC 2002 to make decisions about the diameter of the wire needed for different sections of a solar installation, and to select such cables from the catalogs of suitable vendors. Therefore, a POSITA would understand that the selection of feeder cable size, in the range of 250 MCM to 1000 MCM is an obvious design choice in view of Yamawaki.

[576] For these reasons, a POSITA would have found the claim 17 limitations to be obvious based on the Yamawaki-Shao-Solon741 combination.

[577] In sum, for all of the reasons discussed above regarding Ground 6, it is my opinion that a POSITA would have found claims 11, 16, and 17 to be obvious

in view of Yamawaki, Shao, and Solon741, and therefore should be found invalid under 35 U.S.C. § 103 based on Yamawaki, Shao, and Solon741.

G. Ground 7: Claim 20 is unpatentable under 35 U.S.C. § 103 as obvious in view of Yamawaki, Shao, and Tamura.

(i) Motivation To Combine Yamawaki, Shao, and Tamura

[578] A POSITA would have been motivated to combine Yamawaki, Shao, and Tamura (i.e., the "Yamawaki-Shao-Tamura combination") because all three references discuss the design of cable junction elements that can be used to combine electrical power from a distributed array of solar cells that is convenient, reliable, flexible, and low-cost. Yamawaki discloses photovoltaic modules that may be arranged in various ways to overcome challenges and support the design of a photovoltaic panel array, such as on a home solar energy installation, in addition to improvements to branch junctions that include a molded body (i.e., an undermold) covered by a cover member (i.e., an overmold). *See* EX1006, 7:54-8:11, 10:19-22 and FIG. 9B. Shao discloses designs and manufacturing methods that can be used for joining the main cables and drop lines and providing insulation and molding to protect the junctions. *See* EX1008, 5:31-34, 6:18-30, and 6:40-7:1. Likewise, Tamura is generally directed to cable assemblies that provide "high waterproofing performance by virtue of a double waterproof effect." EX1009, ¶17. The disclosure of Tamura is in the same field of electrical connectors as Yamawaki and Shao, and is thus

analogous prior art, and discloses a "Cable branch molding method." *See id*., ¶3. Tamura also discloses a double-molded structure that provides improved protection from water. *See id*., ¶17. Further, Tamura discloses "arranging multiple solar battery modules comprising a plurality of solar battery cells on a roof or on top of a build and connect the solar battery modules by means of cables." *See id*., ¶2. Accordingly, all three references are in the same field of endeavor.

[579] As described in detail below, Tamura provides further improvements to the Yamawaki-Shao combination by providing a 2-layer molding process that Tamura explains will offer better reliability and performance because of the selection of "PVC resins" for several of the layers of the assembly, and the use of an inner mold part and an outer mold part which provides a "double waterproof effect." *See id*., ¶17.

[580] A POSITA would be motivated to combine the manufacturing methods/designs of Yamawaki and Shao with Tamura, and specifically the addition of the two molding steps of Tamura to the design of Shao, to achieve further improvements in reliability and performance, and to use these detailed designs, processes, and materials, to build the entire catalog of wiring harness components disclosed by Yamawaki.

[581] Further, a POSITA would have understood to achieve these advantages, the

selection of "PVC resins" for several of the layers of the assembly, and the use of an inner mold part and an outer mold part disclosed by Tamura could be successfully applied to the modified harness of the Yamawaki-Shao combination. The precise technical combination and modifications are described further below.

1. Claim 20

The lead assembly of claim 1, wherein the overmold is applied by injection molding.

[582] Tamura discloses applying an injection molded overmold over an undermold of a branch cable connection to provide an added layer of waterproofing. *See* EX1009, ¶¶11, 15-17. In particular, Tamura discloses adding an injection-molded outer mold part 12 (i.e., an overmold) over an inner mold part 11 (i.e., an undermold). *See id*., ¶¶14, 20, 21. It would have been obvious to a POSITA to add an injection molded overmold for added protection against environmental elements, as taught by Tamura (*see* 'H(i) Motivation to Combine Yamawaki, Shao, and Tamura' further discussed above).

[583] For these reasons, a POSITA would have found the claim 20 limitations to be obvious based on the Yamawaki-Shao-Tamura combination.

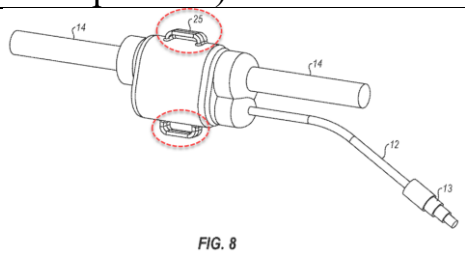
[584] Therefore, in accordance with Ground 7, claim 20 should be found invalid under 35 U.S.C. § 103 based on Yamawaki, Shao, and Tamura.

H. Ground 8: Claims 1-24 are unpatentable under 35 U.S.C. § 112 as being

indefinite.

[585] Every claim of the '153 Patent is invalid under 35 U.S.C. § 112 as indefinite because the intrinsic record fails to inform a POSITA, with reasonable certainty, how to determine whether an "aperture" extends completely through or partially through the [undermold / primary mold] as required by every claim in the '153 Patent.

[586] The term "aperture" is used throughout the claims of the '153 Patent to describe the structure of the undermold in independent claim 1 and the primary mold in independent claims 21 and 24. It is not the same external attachment "aperture" described in the specification, which is identified as "25-Aperture" in the list of "structure numbers" in the specification and discussed in a single sentence: "[o]vermold 24 preferably defines at least one aperture 25 for receiving zip-ties, and the like, for securing the assembly upon installation", reproduced below:

EX1001, 4:6-29; 4:61-63; Figs. 8, 11, 29 (annotated with red circles around "25-Aperture")	
	 FIG. 8

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

The following detailed description describes exemplary embodiments of the invention. The description is not to be taken in a limiting sense but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the appended claims.

The following structure numbers shall apply to the following structures among the various FIGS.:

10—Lead assembly;
12—Drop line;
13—Drop line connector;
14—Feeder cable;
15—Feeder cable connector;
16—Insulation;
17—Joint;
18—Exposed wire;
19—*Nexus;*
20—Compression lug;
22—Undermold;
24—Overmold;
25—Aperture;

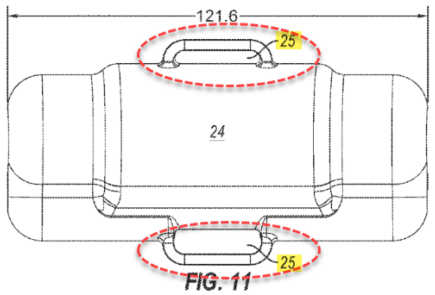


FIG. 11

As shown in FIG. **35**, the drop line and feeder cable are held together by compression lug **20**, which is surrounded by undermold **22** (FIG. **33**), which is surrounded by overmold **24** (FIG. **29**). Overmold **24** preferably defines at least one aperture **25** for receiving zip-ties, and the like, for securing the assembly upon installation.

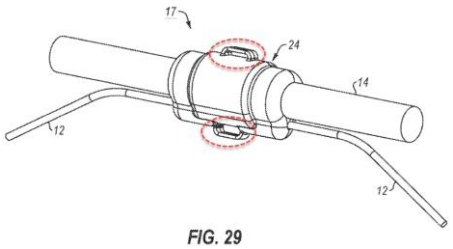


FIG. 29

[587] The specific aperture structures in the claims of the ’153 Patent were introduced by the examiner for the ‘254 patent. In order to overcome prior art references that rendered previous drafts of claims for the ‘254 to be invalid, the Examiner (not the Applicant) proposed a new 113-word amendment, that would bring some of the then-pending claims of the ‘254 application into condition for allowance. The examiner-proposed amendment to the already claimed undermold included new aperture structures with specific characteristics, which included the “first aperture extending continuously through said undermold”

and “second aperture only partially extending through said undermold”. With the examiner-proposed amendment, the ’254 Patent also requires the second aperture and first aperture be parallel, that they extend in the same longitudinal direction, and they be concentric with other structural components of the lead assembly. The patent owner accepted the examiner-proposed amendments without modification.

[588] The amended claims issued into the ’254 Patent and the applicant carried forward these aperture structure limitations into the originally proposed claims for the ’153 Patent, as shown below:

1. A lead assembly for use in a solar energy installation including: A. A first drop line and a second drop line, said first drop line terminating in a drop line connector; B. At least one 30 amp feeder cable terminating in a feeder cable connector, said first drop line and said at least one feeder cable electrically coupled at a nexus; C. A means for securing said nexus, said securing means selected from the group consisting of compression lug, soldering, splicing, crimping, and combinations thereof; D. An undermold having an inner surface and an outer surface, both surfaces extending in a longitudinal direction of said at least one feeder cable, said inner surface surrounding and fully encasing said securing means, said inner surface comprised of a first aperture concentric with said securing means and said at least one feeder cable, said first aperture extending continuously through said undermold in said longitudinal direction and having a first diameter, said at least one feeder cable continuously extending through said first aperture, and a second aperture concentric with said first drop line and parallel to said first aperture, said second aperture only partially extending through said undermold in said longitudinal direction, said second aperture having a second diameter smaller than said first diameter, said first drop line extending from said second aperture; and E. An overmold surrounding said undermold and forming an undermold-overmold interface only at said outer surface, wherein said lead assembly combines power from a plurality of solar arrays and transmits that power to an inverter in a solar energy installation lacking a combiner box between said solar arrays and said inverter, and wherein said lead assembly has a voltage rating of 1500 VDC.	1. A lead assembly for use in a solar energy installation including: a drop line; a feeder cable electrically coupled to the drop line at a nexus; an undermold that fully encases the nexus, the undermold further comprising: a first aperture extending completely through the undermold and having a first diameter, wherein the feeder cable extends through the first aperture along a first longitudinal axis; and a second aperture extending partially through the undermold and having a second diameter different than the first diameter, wherein the drop line extends from the second aperture along a second longitudinal axis; and an overmold surrounding the undermold and forming an undermold-overmold interface at an outer surface of the undermold.
EX1020, claim 1 (issued on 4/23/21)	**EX1002, p. 40 (originally filed claim 1 in '153 Application filed on 4/8/21)**

[589] The examiner did not provide any explanation to support the understanding of the aperture claim language that the examiner proposed. Further, the examiner did not reference any language or figures from the specification to support this new claim language, and the examiner did provide any explanation of how this new language led to claim allowance over the prior art examples cited during prosecution. Nor did the Applicant, in its office action adopting

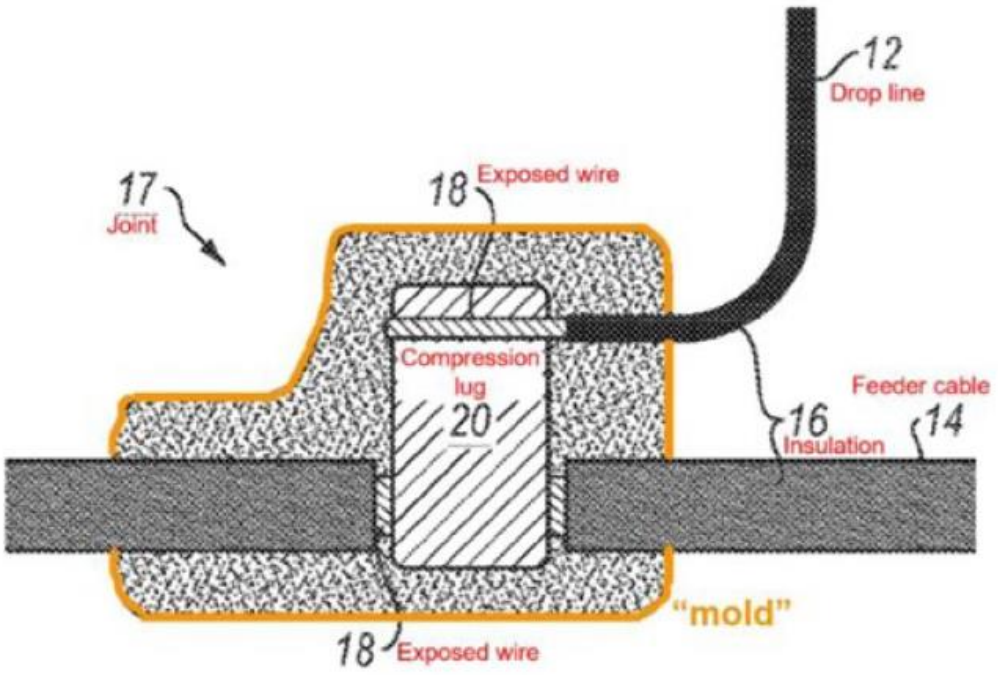
the proposed amendments, provide any explanation on how the Applicant understood the proposed amendments. EX1020, p. 296-307. Rather, the Applicant simply remarked that it was offering the specific claim amendments that Examiner Smith indicated would bring the case into condition for allowance. EX1020, p. 305. In addition, missing from the Applicant's response was the statement "[n]o new matter has been introduced", a representation included in every prior response to an Office Action where an amendment to the proposed claims was made. Compare EX1020, p. 68, 79, 94, 132, 133, 178, 211, 260 and 349. Here though, it was the Examiner, not the Applicant, proposing the amendments. The Applicant presumably did not understand the scope of the proposed amendments, only that the Examiner would allow them

[590] As a result, the intrinsic record offers no guidance to a POSITA on how to understand the aperture structures within the claimed molds, and specifically, how to determine whether an aperture extends completely through or partially through said mold.

[591] The limited disclosure in the '153 Patent and prosecution history, beginning with the '773 Provisional, through the prosecution that led to the '254 Patent and through the issuance of the '153 Patent, leaves a POSITA to speculate as what is the proper understanding or "test" to determine whether an "aperture" extends partially through (or completely through) the [undermold / primary

mold].

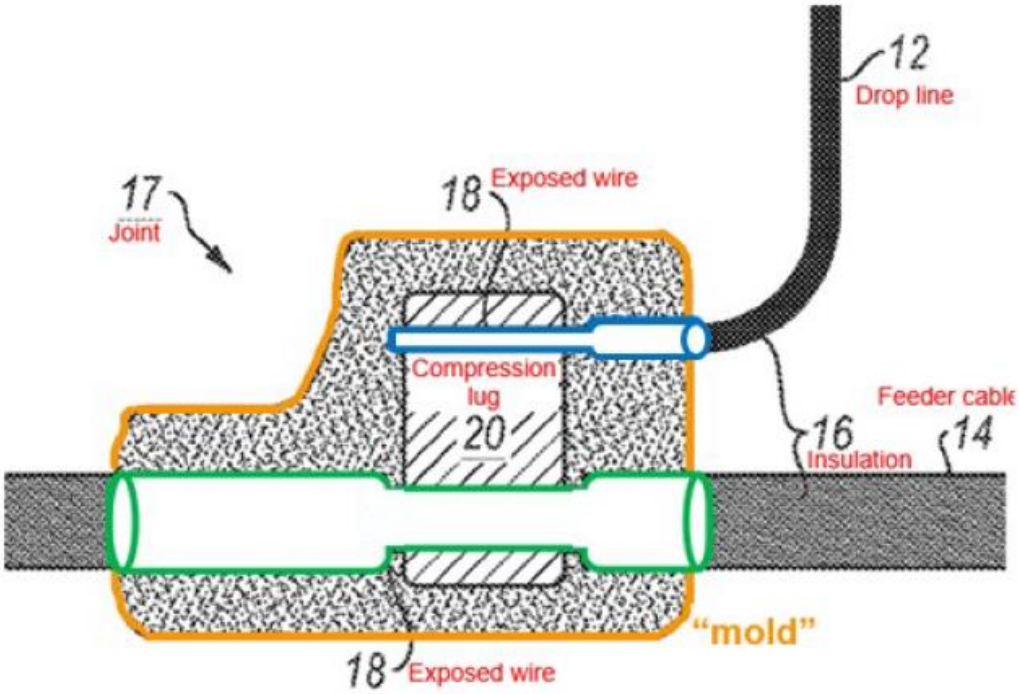
[592] Five potential tests are identified below, and first applied to Figure 7 of the 153 Patent, one of the only figures that depict the internal structure of the [undermold / primary mold]. Annotated Figure 7 is shown below:



[593] **"Entire Cables Removed Test"**: I understand that during the evidentiary hearing in the ITC parallel proceeding that took place on March 18, 2024, one definition of "aperture" that was discussed was a "3-D hole (in other words, the entire pathway for a cable in the [undermold / primary mold]) that exists when viewed as if the entire cable is removed".

[594] Applying this definition of "aperture", annotated Figure 7 with the underlying cables removed is shown below with the entire pathway of the feeder cable outlined in green and the entire pathway of the drop line cable

outlined in blue:



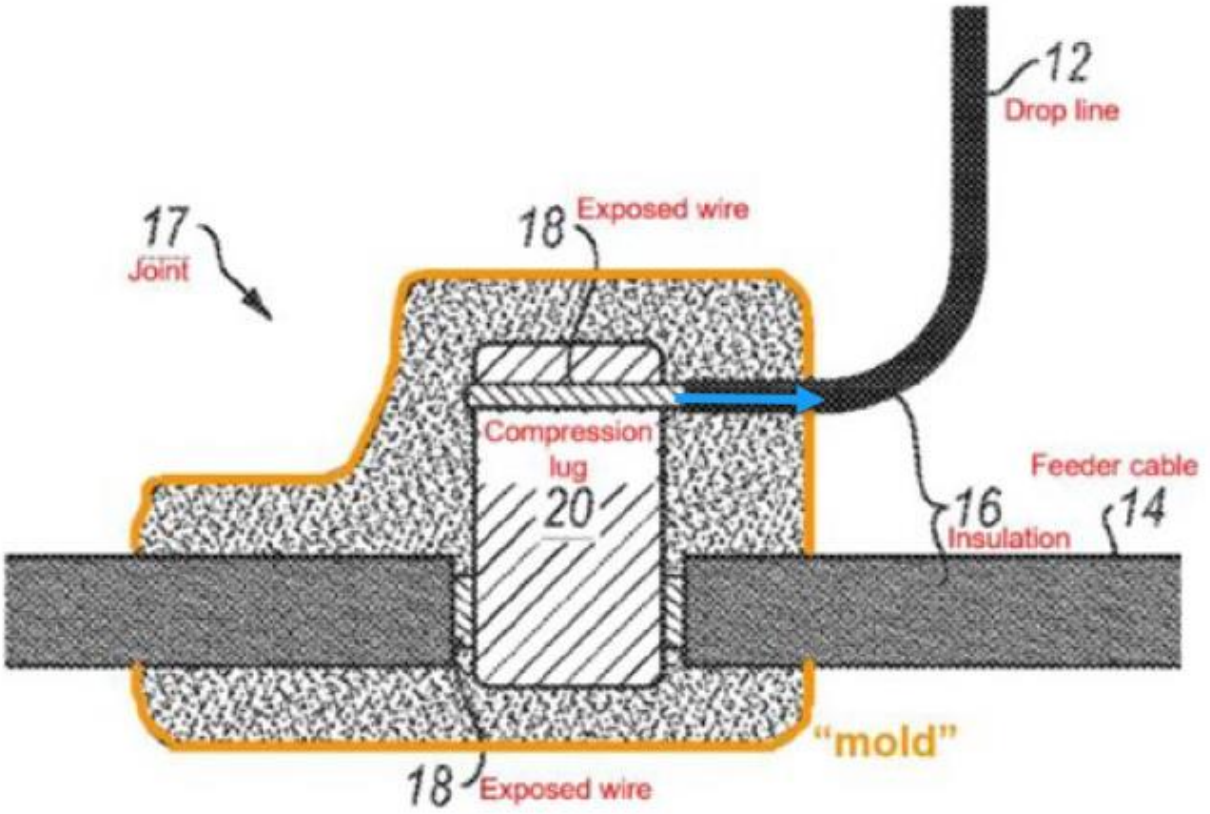
[595] Using the **"Entire Cables Removed Test"**, the first aperture in green (associated with the feeder cable) extends completely through the mold and the second aperture in blue (associated with the drop line cable) extends partially through the mold.

[596] **"See Through Test"**: this test considers whether the opening into the [undermold / primary mold] follows a straight line such that one could "see through" the opening and out the other side of the mold. If yes, the aperture extends completely through, such as in the case of the first aperture above defined by the green outline. If not, the aperture extends partially through, such as in the case of the second aperture above defined by the blue outline.

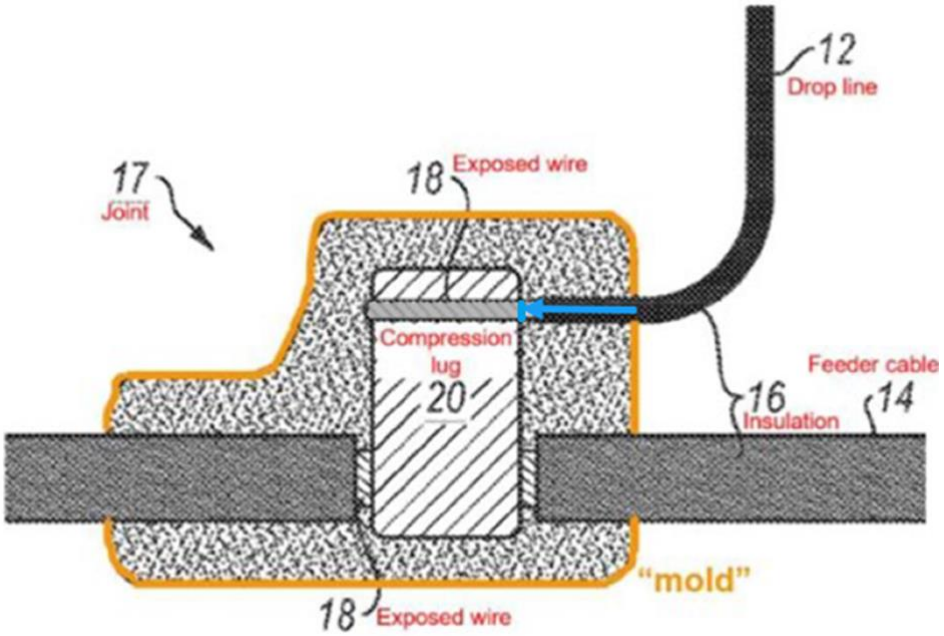
[597] **"Cable Test"**: this test is a modification of the **"Entire Cable Removal**

Test" in that it simply follows the entire pathway of a cable (and ignores any pathways of any other cables within the mold when viewed as if they were removed too). As applied in the above Figure 7, the result is still the same. the first aperture (associated with the feeder cable) extends completely through the mold and the second aperture (associated with the drop line cable) extends partially through the mold. However, in embodiments where, for example, two adjacent cables create joined pathways through the mold, whether the apertures still only extend "partially through" becomes less clear.

[598] **"Start at the Nexus Test"**: this test relies on Patent Owner's litigation position set forth in the parallel ITC proceeding's evidentiary hearing and during the parallel ITC proceeding's earlier Markman hearing. Under this test, any drop line cable that encounters a nexus (e.g., the area of electrical connection between two conductors) necessarily is terminated at the nexus and the aperture associated with that cable would also end at the same location. As applied to Figure 7, the second apertures would only extend partially through the [undermold / primary mold], as would every aperture associated with a drop line cable, regardless of any details associated with the actual orientation and arrangement of the cables entering and traversing the nexus.



[599] **"Effective Physical Pathway Test"**: this test relies on a theory presented by counsel for Patent Owner during the Markman hearing in the parallel ITC proceeding. The test contemplates that when the cable associated with the drop line enters the compression lug and the lug is crimped, the cable is crushed and distorted in a way that makes it essentially disappear within the lug. In that regard, there would no longer be a physical pathway associated with the drop line cable or wire, and as a result, no aperture that could pass all the way through the lug. An annotated version of Figure 7 is shown below

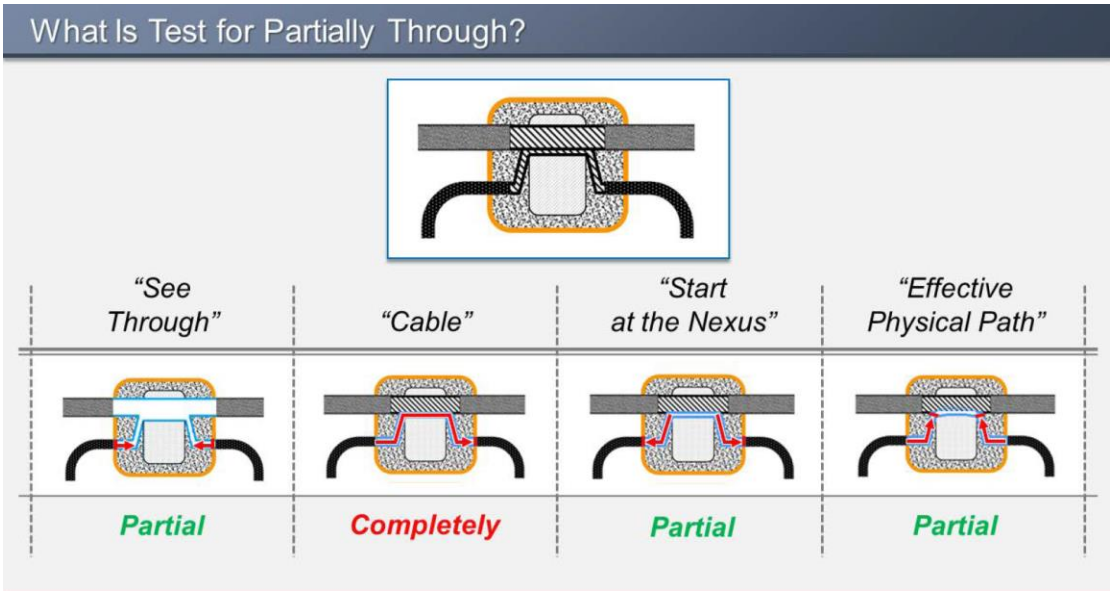


[600] For each of the above tests, the second aperture associated with the drop line cable of figure 7 extends partially through the mold. However, when the tests are applied to mold structures involving multiple drop lines or branches, depending on whether the apertures are formed with a single cable or two cables, depending on whether there are bends within the mold, whether the aperture terminates or begins at the nexus, or whether the cable is crushed into the compression lug, the determination of whether the second aperture extends partially through will vary.

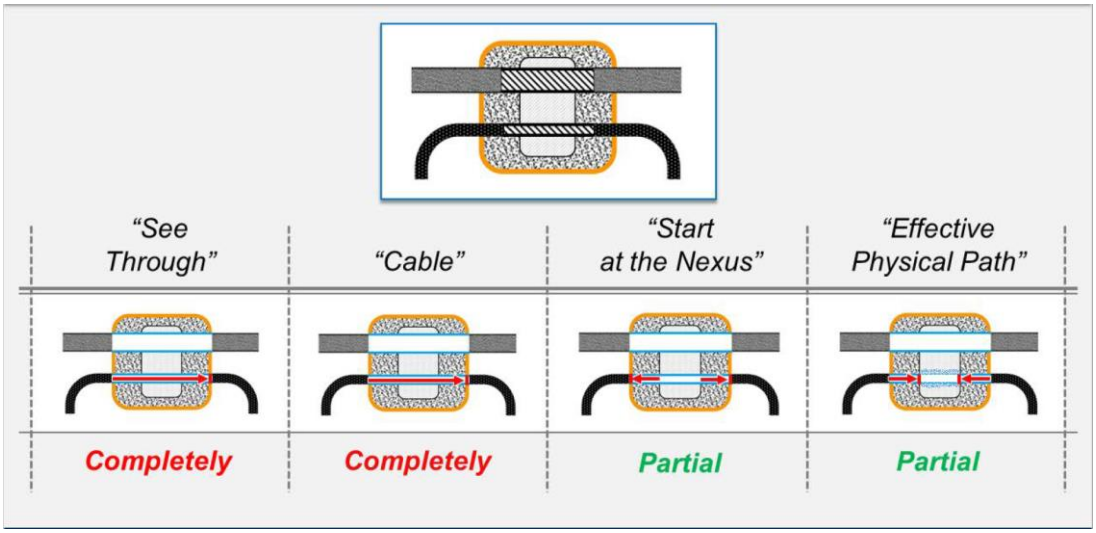
[601] As shown in in the demonstrative below, applying the "See Through Test", "Cable Test", "Start at the Nexus Test" and "Effective Physical Pathway Test" to different mold structures with different configurations of cables reach different results. I presented these different tests during live testimony at the

evidentiary hearing in the parallel ITC proceeding on March 22, 2024 in support of my opinion that the claims of the '153 Patent are indefinite, including the demonstrative images shown below for each of the four hypothetical cable assembly structures.

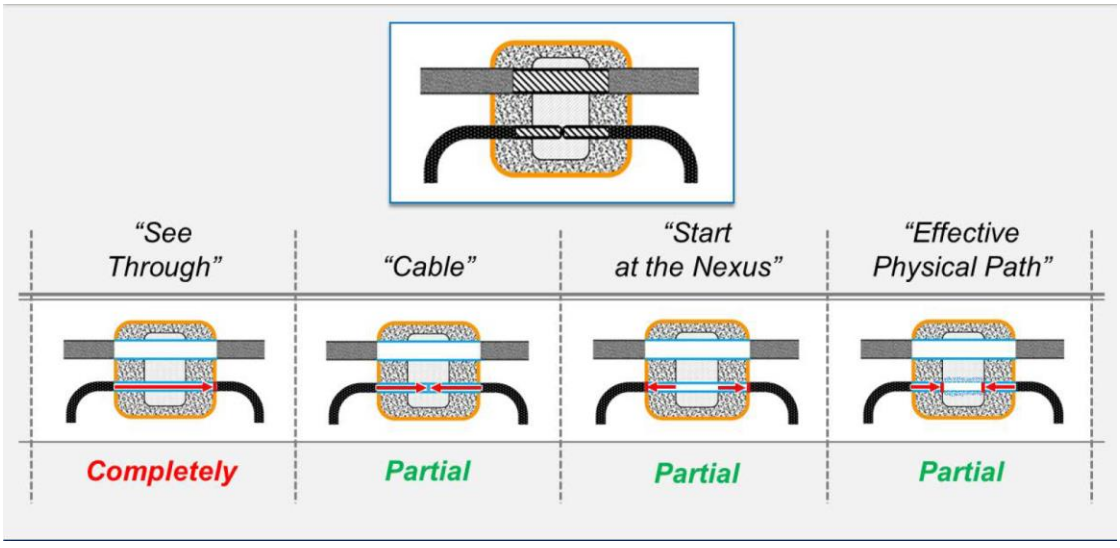
[602] **Structure 1** below shows a dual drop line cable that forms two branches, where the cable enters the mold parallel to the feeder cable, bends at an angle towards the nexus, runs parallel to the feeder cable through the nexus, bends at an angle away and out of the nexus, and then parallel again to the feeder cable as it exits the mold.



[603] **Structure 2** below shows a dual drop line cable that forms two branches, where the cable enters the mold parallel to the feeder cable through the nexus and out the other end of the mold.

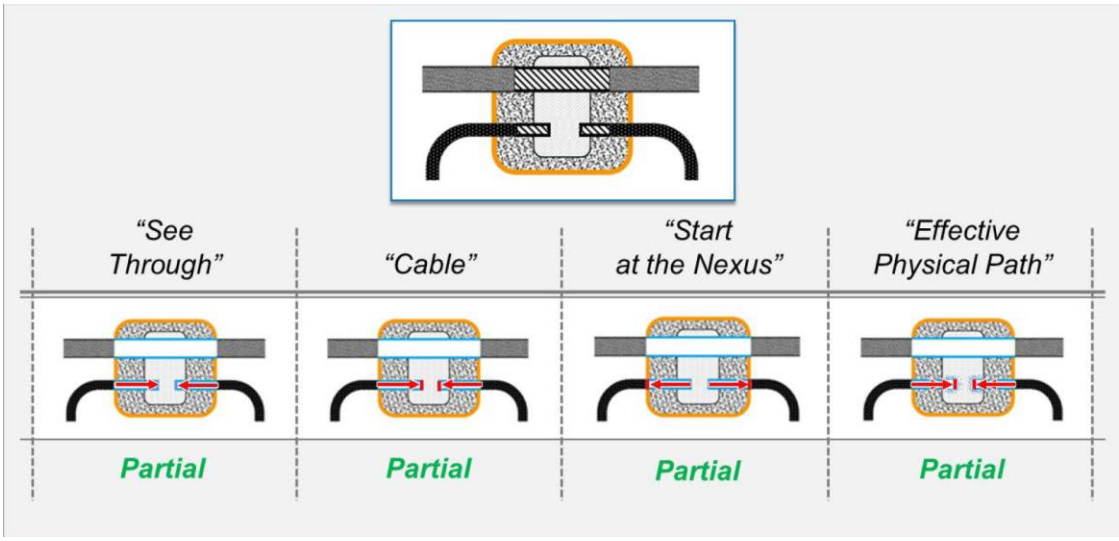


[604] **Structure 3** below shows two distinct drop line cables that each form a branch, where each cable enters the mold parallel to the feeder cable and into the middle of the nexus where each drop line cable terminates adjacent to one another. When both drop line cables are removed, an entire pathway through the nexus is formed, which introduced one difference between the "Cable Test" and the "Entire Cables Removed Test".

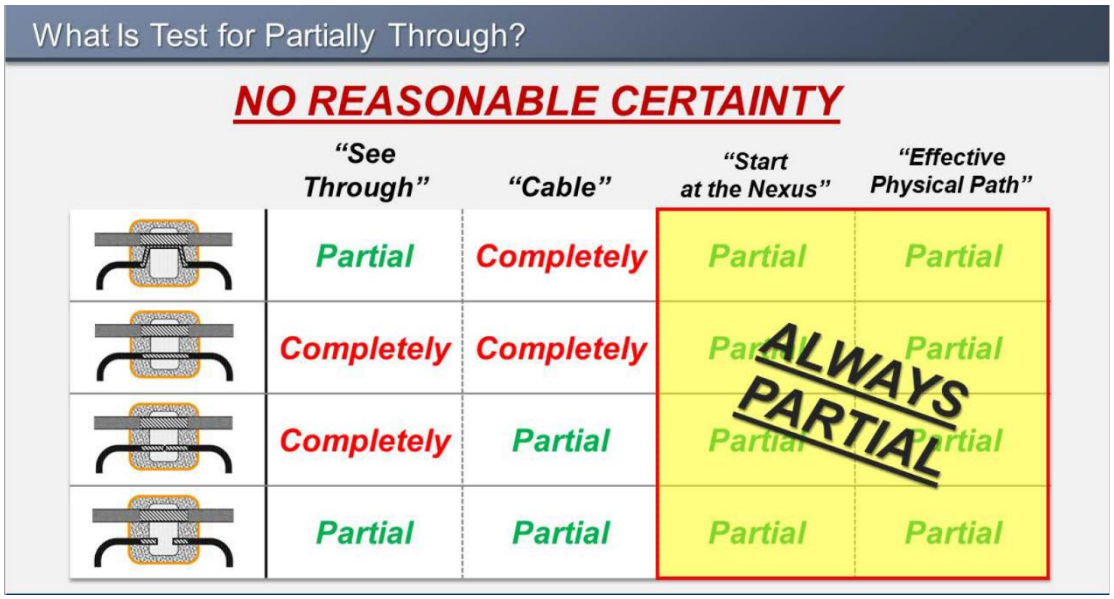


[605] **Structure 4** below shows two distinct drop line cables that each form a

branch, where each cable enters the mold parallel to the feeder cable and into the edge of the nexus where each drop line cable terminates. When both drop line cables are removed, an entire pathway through may or may not form, depending on whether mold material fills the space between the two drop line cables within the nexus. This introduces another difference between the "Cable Test" and the "Entire Cables Removed Test".



[606] To summarize the results of each of those four tests when looking at the four different potential exemplary mold structures based on the cable(s) forming apertures within, the chart below illustrates how without having reasonable certainty as to which test to apply, a POSITA cannot with reasonable certainty understand the metes and bounds of the claims of the '153 Patent.



[607] In sum, for all of the reasons discussed above regarding Ground 8, it is my opinion that each claim, claims 1-24, of the '153 Patent is invalid as indefinite under 35 U.S.C. § 112 because the intrinsic evidence fails to inform a POSITA, like myself, the scope of the invention with reasonable certainty. As I have summarized above, the origin of the "aperture" term as it is used in the '153 patent is based on a proposed amendment introduced by the examiner, and which was accompanied by no explanation as to how to interpret whether such an aperture extends completely or partially through a mold.

[608] I understand that, even with a lack of express verbal explanation, the disclosed figures in a patent may be sufficient to determine whether one of ordinary skill would reasonably understand the inventors to be in possession of the invention.

[609] In looking to the figures disclosed in the '153 patent, I believe that Figure 7

provides some confirmation that the inventor had possession of a single drop lead assembly with a drop line that extends partially through a mold. In Figure 7, drop line 12 appears to enter a mold, then through a compression lug, then out of a nexus, but does not traverse completely through the mold on the other end to exit the mold. This may be understood to depict a drop line extending partially through the mold for this single drop embodiment.

[610] However, for a dual drop embodiment, there do not appear to be any figures that depict the mold structure in which an aperture would be formed, particularly as to how the aperture would form over one or two drop line cables, how and where they are, or are not, in contact with the mold, and whether and how the aperture in the mold would be extending partially through the mold, rather than an aperture extending completely through the mold. As a result, in sum, it is my opinion that each of claims 1-24 of the '153 patent is invalid for failure for written description because one of ordinary skill would not have reasonably concluded that the inventor was in possession of a claimed dual drop embodiment with apertures that partially extend through a mold.

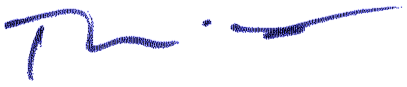
V. CONCLUSION

[611] I reserve the right to supplement my opinions to address any information obtained, or positions taken, based on any new information introduced

throughout this proceeding.

[612] I declare under penalty of perjury that the foregoing is true and accurate to the best of my ability.

Dated: March 27, 2024

By: 

Thomas W. Kenny, Ph.D.