IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HS HYOSUNG ADVANCED MATERIALS CORP.,

Petitioner,

v.

KOLON INDUSTRIES INC.,

Patent Owner.

Case No. IPR2025-00663

U.S. Patent No. 10,196,765

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,196,765

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LIST OF CHALLENGED CLAIMS

Claim No.	Claim Language
1[pre]	A hybrid tire cord comprising:
1[a]	a nylon primarily twisted yarn; and
1[b]	an aramid primarily twisted yarn,
1[c]	wherein the nylon primarily twisted yarn and the aramid primarily twisted yarn are secondarily twisted together,
1[d]	if the secondary twist of the hybrid tire cord with a predetermined length were untwisted, a length of the aramid primarily twisted yarn would be 1.005 to 1.025 times a length of the nylon primarily twisted yarn,
1[e]	the aramid primarily twisted yarn has a 0.1 to 5% lower twist number than a twist number of the nylon primarily twisted yarn, and
1[f]	the hybrid tire cord has a merge structure having a partial covering structure.
2[pre]	The hybrid tire cord according to claim 1, wherein the nylon primarily twisted yarn has a first twist direction,
2[a]	the aramid primarily twisted yarn has a second twist direction,
2[b]	the nylon primarily twisted yarn and the aramid primarily twisted yarn are secondarily twisted together in a third twist direction,
2[c]	the second twist direction is the same as the first twist direction, and
2[d]	the third twist direction is opposite to the first twist direction.

Claim No.	Claim Language
3	The hybrid tire cord according to claim 1, wherein a weight ratio of the nylon primarily twisted yarn to the aramid primarily twisted yarn is 20:80 to 80:20.
4[pre]	The hybrid tire cord according to claim 1, further comprising an adhesive agent coated on the nylon primarily twisted yarn and the aramid primarily twisted yarn,
4[a]	wherein strength at break and elongation at break measured by ASTM D885 (2004) are 8.0 to 15.0 g/d and 7 to 15%, respectively, and
4[b]	a strength maintenance percentage after disk fatigue test conducted by JIS-L 1017 (2008) of Japanese Standard Association (JSA) is 90% or higher.
5	The hybrid tire cord according to claim 4, wherein the hybrid tire cord has 3% LASE, 5% LASE, and 7% LASE measured by ASTM D885 (2004), of 0.8 to 2.0 g/d, 1.5 to 4.0 g/d, and 3.0 to 6.0 g/d, respectively.
6[pre]	The hybrid tire cord according to claim 5, wherein the hybrid tire cord has a shrinkage of 1.5 to 2.5%,
6[a]	wherein the shrinkage is measured under a primary load of 0.01 g/denier at 180 ° C. for 2 minutes.

I. INTRODUCTION

HS Hyosung Advanced Materials Corp. ("Petitioner") respectfully request *inter partes* review of claims 1-6 of U.S. Patent No. 10,196,765 (the "'765 patent"). A reasonable likelihood exists that Petitioners will prevail on at least one challenged claim.

The '765 patent relates to a hybrid tire cord formed by twisting a nylon thread and an aramid thread in one direction to form, respectively, a nylon yarn and an aramid yarn, then twisting the two yarns in the opposite direction to form a raw tire cord. While the '765 patent concedes that nylon-aramid hybrid tire cords were well-known, the '765 patent purports to invent a new method where the nylon and aramid yarns are twisted in the same direction by a single twister, and that the aramid yarn is slightly longer and has slightly fewer twists than the nylon yarn.

However, such techniques were known in the art decades before the earliest filing date of the '765 patent, June 29, 2015. This petition relies on Nakayasu and Fritsch to challenge the independent claim, both of which were published between 1993 and 2003.

Indeed, the notion that it was desirable for a tire cord's yarns to have different yarn lengths was well-known. This itself is taught in the Fritsch reference published in 2003, which is directed to forming a hybrid tire cord and explains that altering the tension of the yarns can create an "unbalanced" tire cord where the higher modulus yarn is longer than the lower modulus yarn, resulting in improved physical properties.

Nakayasu, which was filed by Sumitomo Rubber Industries and published in 1996, describes the benefits of a nylon-aramid hybrid tire cord. Nakayasu explains that given the different physical properties of the two materials, it is beneficial to create a tire cord where the nylon and aramid threads are twisted in one direction to form nylon and aramid yarns, and then the yarns are twisted in the opposite direction to form the tire cord. This results in a tire cord with low stress.

II. STANDING

Petitioner certifies that the ’765 patent is available for *inter partes* review and they are not estopped from requesting IPR under 35 U.S.C. §315(e)(1).

III. GROUNDS

Petitioner presents the following grounds of challenge.

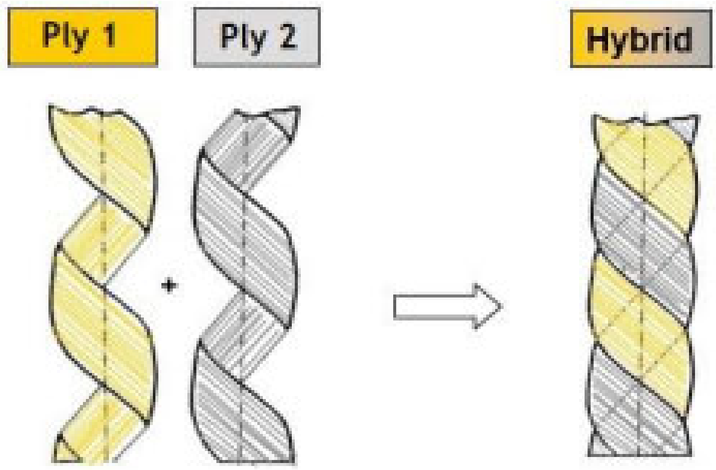
Ground	Basis	Prior Art	Claims
1	§103	Nakayasu, Fritsch	1-6
2	§103	Nakayasu, Fritsch, Tamura, Chung, Yokokura, Shepherd, Rowan	4-6

IV. ’765 PATENT OVERVIEW

A. Background of Technology (Ex. 1003, ¶¶37-43)

One of the most important parts of a tire is its reinforcement. It provides strength and stability to the tire, like bones in a human body. Tire reinforcements can be made of various materials, including textiles. Originally, textile reinforcements were made of cotton, which was slowly replaced by rayon. And at the time of the '765 patent, nylon and aramid tire reinforcement materials were prevalent—particularly for use in the tire's cap ply. The "use of tire cords made from high tenacity organic fibers such as rayon, nylon, aramid, and polyester in a construction of moderate twist has remained the principal reinforcing method." Ex. 1015, ¶5.

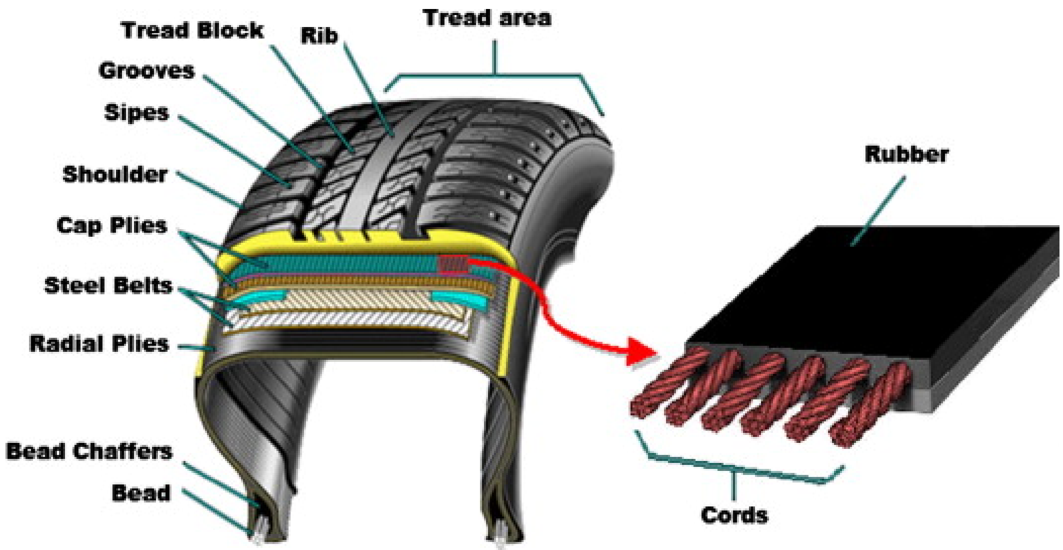
One important way to enhance tire performance is to improve the physical properties of the tire cord used as a reinforcing material. Ex. 1021 (Kwon), ¶2. Previously, reinforcement cords were entirely nylon or entirely aramid. Aramid is a high-tenacity, high-modulus, low-elongation, and thermally-stable material. And nylon 6.6 is a high elongation, low-modulus, high-fatigue-resistant material. In the early 2000's, Michelin developed a new textile reinforcement which combined the beneficial aspects of nylon and aramid and significantly improved high-performance tires—i.e., the nylon-aramid hybrid reinforcement cord. Hybrid cords are a combination of two or more types of yarns plies twisted together (e.g., a nylon yarn and an aramid yarn).



Wahl, G., Basics of Textile Reinforcement Materials for Tires (2006).

Each ply is twisted on its own axis and then with another ply before it is formed into a cord. The ply twisting directions are denoted by “z” and “s”. If the direction of twist is from right to left, it is called “z” twist, and if the direction of twist is from left to right, it is called “s” twist. In some instances, each individual ply is twisted in the “z” direction and then the two individually-twisted plies are twisted together in “s” direction to form a cord. Twisting causes the cord to lose tensile strength, but it simultaneously gains flex fatigue resistance. Hence the number of times a ply is twisted must strike a balance between tensile strength and flex fatigue resistance.

Further, because textile fabric adheres poorly to rubber, the textile reinforcements have long been treated with adhesive solutions, commonly Resourcinol-Formaldehyde-Latex or other epoxies, which acts as a bonding agent between the textile reinforcement cord and the rubber tire. The illustration below shows how reinforcement cords adhere to a rubber cap ply.



Drying and heat treating—i.e., stretching the textile cords at high temperatures—typically follows. This process reduces undesired thermal shrinkage.

On balance, aramid-nylon hybrid reinforcement cords were known to have better properties than the prior aramid-aramid and nylon-nylon cord constructions. For instance, when compared with aramid-aramid cords, the hybrid cords have improved fatigue resistance, higher elongation, lower raw material cost, and controlled shrinkage. And when compared with nylon-nylon cords, the hybrid cord will have a lower shrinkage, improved handling and cornering stability, speed performance, and rolling resistance.

B. Specification

The ’765 patent relates to “a hybrid tire cord including heterogeneous yarns having different physical properties," and specifically that an aramid yarn is 1.005 to 1.025 times longer than the nylon yarn it is twisted with. Ex. 1001, 1:16-18; cl. 1; Ex. 1003, ¶¶44-47.

The specification acknowledges that the typical materials for tire cords are nylon and aramid. *Id.*, 1:48-49. Nylon has "low cost, superior adhesivity and superior fatigue resistance," but "has a problem of causing flat spots due to low modulus and great deformation with variation in temperature." *Id.*, 1:49-56. Aramid, on the other hand, has "almost no flat spot phenomenon" due to "very high modulus," but is "very expensive." *Id.*, 1:57-64. Tire molding is also relatively more difficult due to the high modulus. *Id.*, 1:64-67.

The specification explains that it was known that such disadvantages with each material could be solved by a "hybrid cord to which both nylon and aramid are applied." *Id.*, 1:1-3. The specification acknowledges that "[t]ypically," the aramid yarn has a "greater twist number" compared to the nylon yarn, and the yarns are twisted in opposite directions. *Id.*, 2:7-15. However, the specification alleges this method has "low production efficiency" because it requires a three-step process due to the yarns being twisted in opposite directions: (1) twisting the nylon yarn in one direction, (2) twisting the aramid yarn separately and in the opposite direction, and (3) twisting the two yarns together. *Id.*, 2:25-33. Moreover, because the aramid yarn has a higher twist number, the strength of the aramid is "greatly deteriorated." *Id.*, 2:44-49.

Thus, the specification claims to invent a new method where the nylon and aramid yarn are twisted in the same direction, and thus "are conducted in one twister, thereby improving production efficiency," although this feature is not claimed. *Id.*, 3:33-38, 4:48-51. The alleged new method also uses less twists for the aramid yarn relative to the nylon yarn. *Id.*, 3:52-57. Finally, the aramid yarn is "1.005 to 1.025 times" the length of the nylon yard when the cord is untwisted. *Id.,* 3:33-42.

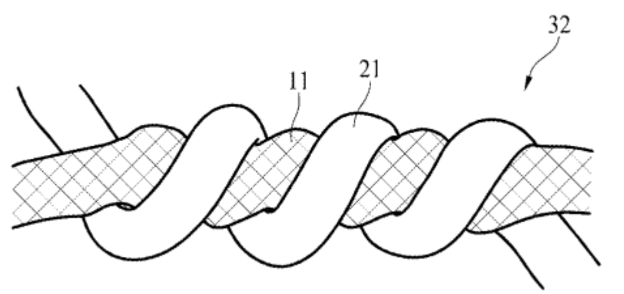
C. Prosecution History of the '765 Patent (Ex. 1003, ¶¶48-65)

The application to the '765 patent was filed December 29, 2016 and claims priority to a June 29, 2015 Korean patent application.

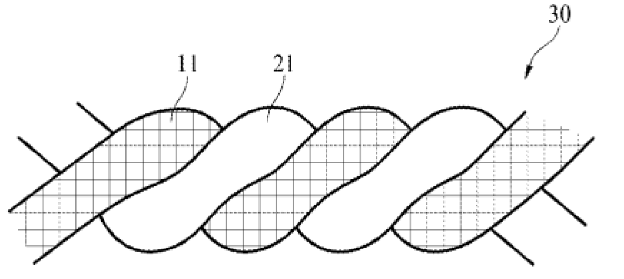
The original application's claims did not recite the limitation that the tire cord has a "merge structure having a partial covering structure." The examiner found that all of the original claims 1-6 were unpatentable over Love in view of Shepherd. Ex. 1002, 2-5. The examiner argued that while Love "fails to specifically teach" the specific claimed range of 0.1 to 5% lower twist number of the aramid yarn relative to the nylon yarn (Love instead teaches a larger range), it would have been obvious "to have utilized such a range, since it is understood that the degree of twist and longer length both contribute to the breaking strength of the material" and that a POSITA would have found the claimed range "through routine experimentation." Ex. 1002, 82.

The applicant did not respond by amending the claims, but instead argued that the claimed tire cord "has a merge structure having a partial covering structure" (not yet recited in the claims), which was not found in Love. Ex. 1002, 69. The applicant argued that "because the length of the aramid primarily twisted yarn is 1.005 to 1.025 times the length of the nylon primarily twisted yarn … after the secondary twist is untwisted, the hybrid tire cord can have a merge structure having a partial covering structure." Ex. 1002, 70.

The applicant then went on to use figures from the application to distinguish the prior art tire cords. One such cord had what the applicant described as a "covering structure" with the aramid yarn 21 "covering" the nylon yarn 11, as shown in the below figure provided by the applicant. Ex. 1002, 71.



By contrast, the applicant argued that the below figure depicts a "merge structure" where the aramid yarn "has the identical structure" with the nylon yarn:



However, the examiner issued a final rejection with the same wording as the first rejection. Ex. 1002, 61-62.

In response, the applicant amended claim 1 to include "the hybrid tire cord has a merge structure having a partial covering structure." The applicant then went on to make similar arguments as it did in its first response, though added additional details. First, the applicant argued that Love does not disclose the specific ranges for the differences in twist number ***and*** yarn length. Ex. 1002, 38.

The applicant then clarified that the first figure is a "conventional hybrid tire cord" where "the number of twist of the aramid primarily twisted yarn, the number of twist of the nylon primarily twisted yarn, and the number of twist of the secondarily twisted hybrid tire cord are different from each other." Ex. 1002, 39.

The applicant then went on to explain that the tire cord in the second figure has a "merge structure" produced "by secondarily twisting a nylon primarily twisted yarn and an aramid primarily twisted yarn, which have been primarily twisted in the same direction, in a direction opposite to the direction, wherein the secondary twisting is conducted such that the nylon and aramid primarily twisted yarns <u>have</u>

<u>an identical structure</u>." Ex. 1002, 40. In other words, the specific twisting direction as claimed in claim 2 (where in the aramid and nylon yarns are twisted in the same direction, then twisted together in the opposite direction), and the yarns having an "identical structure," results in the merge structure of Figure 2. However, the applicant clarified that the second figure embodiment "also has a drawback because the aramid primarily twisted yarn has a higher modulus than the nylon primarily twisted yarn and, thus, stress is intensely applied to the aramid primarily twisted yarn upon repeated tension and compression of tires, which inevitably causing a low fatigue resistance of the tire cord and resulting in a difficulty of securing safety of tires during long-term high-speed driving." Ex. 1002, 40.

Thus, the applicant argued that the claimed hybrid tire cord has a "merge structure having partial covering," which solves the both problems of the applicant's Figure 1 and Figure 2. The applicant provided experimental data showing that "twist number of the aramid primarily twisted yarn is increased and the length of the aramid primarily twisted yarn is controlled to be longer than the nylon primarily twisted yarn," resulting in the claimed improved tire cord. Ex. 1002, 41-42. In other words, the applicant argued that the "merge structure having partial covering" is a result of the specific claimed differences in twist numbers and length of the yarns.

The applicant went on to provide additional experimental results from an experiment where applicant "attempted to produce a raw cord according to the process [and materials] described in Love" and tested their properties. Ex. 1002, 42-45. Notably, the applicant was able to produce raw cords that met the claimed differences in twist number and length. *Id.* The applicant then noted that the test data for these raw cords "clearly demonstrate ***that the claimed hybrid tire cords exhibit superior uniformity of physical properties, superior fatigue resistance***." Ex. 1002, 45. Applicant argued, however, that such superior results "only could be obtained thanks to the ***particular combination of the twist number and the different lengths of the aramid and nylon yarns*** contained in the dip cord, wherein the differences were finely controlled during the dip cord manufacturing process by way of heat treatment and tension applications; and such conditions and the superior results were not predicted or expected from the teaching of Love which is silent on these conditions." *Id.*, 45.

Following this response, the examiner allowed the claims, though did not provide any explanation. Ex. 1002, 22.

In view of the above, applicant was able to obtain allowance by (1) amending the claims to add the limitation of the tire cord having a "merge structure having a partial covering structure," (2) arguing that such structure is a result of the specific claimed difference in twist number and yarn length, and (3) that this specific claimed different in twist number and yarn length resulted in improved physical properties that were unexpected and therefore would not have been obvious based on Love's teachings.

However, as discussed below, the specific claimed difference in twist number and yarn length were well-known in the art, and in view of those teachings, it would have been obvious to incorporate them into an aramid-nylon hybrid cord.

V. Level of Ordinary Skill in the Art

A person of ordinary skill in the art ("POSITA") at the time of the '765 patent would have had at least a Bachelor of Science degree in materials science and engineering, textile engineering, chemistry, or an equivalent field, and at least two years of experience with tire reinforcement cord design and manufacture, and/or fiber or polymer science and processing. Ex. 1003, ¶36. More education can supplement practical experience and vice versa. *Id.* Petitioners' expert, Dr. Jon Rust, exceeded this skill level by the priority date and therefore has the qualifications and experience necessary to the '663 patent based on the perspective of a POSITA. *Id.*

VI. Claim Construction

The claim terms should be given their plain and ordinary meaning under *Phillips*, and "construed only to the extent necessary to resolve the controversy." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011). Here, Petitioner submits that no express constructions are required to find the '765 patent claims unpatentable. Ex. 1003, ¶¶66-67. While the specification of the '765 patent does provide descriptions of certain terms found in the limitations, as discussed below, these definitions are consistent with their plain meaning. Ex. 1003, ¶68. Thus, without conceding that such descriptions are lexicographical, Petitioner adopts these descriptions as definitions for their respective term.

A. "primarily twisted yarn"

The specification of the '765 patent states that the term "primarily twisted yarn" "refers to a single yarn made by twisting one filament yarn in one direction." Ex. 1001, 5:29-31; Ex. 1003, ¶69.

B. "plied yarn"

The specification states that this term "refers to a yarn made by twisting two or more primarily twisted yarns together in one direction." *Id.*, 5:32-34. The specification notes that this term is "also called a 'raw cord.'" *Id.*; Ex. 1003, ¶70.

C. "tire cord"

The specification states that the term "tire cord" "includes the 'raw cord' as well as 'dip cord' which means a plied yarn containing an adhesive agent so that it can be directly applied to rubber products." *Id.*, 5:35-38. In other words, a tire cord can mean either an untreated raw cord, or a dip cord that is the result of dipping a tire cord into an adhesive agent solution to apply it to a rubber product. Ex. 1003, ¶71.

D. "twist number"

The specification states that the term "twist number" "means the number of twists per one meter and its unit is TPM (twist per meter)." *Id.*, 5:42-43; Ex. 1003, ¶71.

E. "merge structure having a partial covering structure"

In the parallel litigation, Petitioner has asserted this term is indefinite because the term "partial" lacks definite boundaries. Ex. 1040, 19-22. On the other hand, Patent Owner proposes a construction of "a structure where both the nylon and aramid yarns have been twisted together where each yarn partially covers the other." *Id.*

For the purposes of this proceeding only, Petitioner analyzes this limitation using Patent Owner's proposed construction. Ex. 1003, ¶¶73-74.

Petitioner, however, notes that, as explained above, the applicant argued during prosecution that this limitation is distinguishable from Figure 1's depiction of a "covering structure" where only one yarn covers the other yarn ***and*** Figure 2's depiction of a "merge structure" where the yarns have "identical structure," since both tire cords exhibited problems. Ex. 1002, 40-42. The applicant argued that a "merge structure having a partial covering structure … solves [these] problems" because of the claimed differences in yarn length and twist number. Ex. 1002, 40-45, 45 ("[S]uch superior results only could be obtained thanks to the ***particular***

combination of the twist number and the different lengths of the aramid and nylon yarns contained in the dip cord").

In addition, the specification notes that in the claimed embodiment, "the length of the aramid primarily twisted yarn is 1.005 to 1.025 times the length of the nylon primarily twisted yarn"—"***[t]hat is***, the hybrid tire cord of the present invention has a ***merge structure having a partial covering structure***." Ex. 1001, 5:67-6:4.

Thus, Petitioner notes that applicant argued that the claimed "merge structure having a partial covering structure" is a result of the claimed difference in yarn length and twist number. Ex. 1003, ¶¶75-76. For purposes of this proceeding only, Petitioner also construes the term to include a tire cord with said claimed differences.

VII. PRIOR ART SUMMARY

A. Nakayasu (Ex. 1007)

U.S. Pat. No. 5,558,144 ("Nakayasu") was issued September 24, 1996 and is prior art under at least 35 U.S.C. §102(a)(1).

Nakayasu discloses a tire cord made from twisting two primarily twisted yarns of different materials: nylon and aramid. Ex. 1007, 2:44-2:67 ("[A] pneumatic radial tire comprises … ***the hybrid cord*** comprising a low elastic modulus thread and a high elastic modulus thread"); 3:16 ("[T]he low elastic modulus fiber, ***nylon fibre***"), 5:23-24 ("To form a high elastic modulus thread 21, one or more ***aramid fibers*** are first-twisted together in a certain direction.”). Nakayasu discloses that the nylon fiber and the aramid fiber are twisted in the same direction to form their respective threads, and then the two threads are “finally-twisted together … to form a hybrid cord 23.” *Id.*, 5:23-28. The threads are twisted “in the reverse direction to the first-twist.” *Id.*; Ex. 1003, ¶¶77-78.

B. Fritsch (Ex. 1023)

U.S. Pat. Pub. App. No. 2003/0159768 (“Fritsch”) was published August 28, 2003 and is prior art under at least 35 U.S.C. §102(a)(1).

Fritsch teaches a method for creating a cord with an “unbalanced configuration” which “means that at least two yarns [of the cord] have different lengths.” *Id.*, ¶19. Fritsch notes that its method results in a “hybrid cabled cord of polymeric materials having excellent properties at a reduced capital cost and is useful as a tire cord.” Ex. 1023, ¶2. Fritsch notes that conventionally, the design of cabling machines “is intended to achieve a balanced tension control in the cabled cord produced which effectively means that the two yarns are pulled off with the same rate and thus equal lengths are incorporated into the cabled cord.” *Id.*, ¶24. However, Fritsch’s inventors discovered that “modulat[ing] the tension on the individual plies” can result in an “unbalanced configuration” where one yarn is longer than the other when untwisted. *Id.*, ¶25. This results in a cord with “greater tensile strength retention.” *Id.*, ¶27. Fritsch describes the difference in length of the yarns as a Coring level, which is the percentage difference in length of the higher modulus yarn relative to the lower modulus yarn. *Id.*, ¶¶19-20. For example, a Coring level of 5% means the higher modulus yarn is 5% longer than the lower modulus yarn. *Id.*; Ex. 1003, ¶¶79-81.

Fritsch provided experimental results that showed an improvement with unbalanced configurations, *i.e.* a non-zero Coring level. Ex. 1003, ¶82. Specifically, Fritsch tested 10 "inventive examples" using PEN (polyethylene napthalate) and PET (polyethylene terephthalate) materials, with Coring level ranges from -15% to 15%, and compared their physical properties to three cords with 0% Coring level. These results are shown in Table 1, reproduced below. *Id.*, ¶40. The table shows that having a positive Coring level results in "a combination of a high breaking strength and a high elongation at break." *Id.*, ¶41. Fritsch notes that the desired combination of "physical properties (breaking strength, elongation at break, energy to break and modulus) can be optimized by an appropriate coring level." *Id.*

TABLE 1

Inv. Ex.	Comp. Ex.	Cord components	Coring level	Breaking Strength (N)	Elongation at Break (%)	LASE at 1.6% (N)	LASE at 3% (N)	Elongation (%) at 45 N
	A	PEN/PEN	0	199.2	10.4	21.4	48.7	2.7
1		PEN/PET	−15%	154	n.d.	n.d.	n.d.	n.d.
2		PEN/PET	−12.2%	154.3	9.3	20.8	45.4	3.1
3		PEN/PET	−9.2%	160.8	10.2	17.5	40.5	3.4
4		PEN/PET	−6.3%	164.7	11.1	16.5	32.8	4.0
5		PEN/PET	−3.2%	170.1	11.4	15.7	33.9	3.9
	B	PEN/PET	0	180.5	12.4	15	32.7	4.1
6		PEN/PET	0.9%	184	12.8	14.6	33.7	4.1
7		PEN/PET	4.5%	184.5	13.8	13.8	30.8	4.3
8		PEN/PET	7.7%	183.5	15.4	13.2	28.6	4.6
9		PEN/PET	13.9%	170.4	16.3	12.8	27.6	4.7
10		PEN/PET	15%	170	n.d.	n.d.	n.d.	n.d.
	C	PET/PET	0	177.7	18.9	12.5	26.2	5.2

VIII. GROUND 1: NAKAYASU IN VIEW OF FRITSCH RENDERS OBVIOUS CLAIMS 1-6

Nakayasu describes a nylon yarn and an aramid yarn twisted in one direction, which are then twisted in an opposite direction to form a hybrid tire cord. Nakayasu describes an embodiment where the aramid yarn has a slightly lower twist number than the nylon yarn. And Fritsch discloses applying less tension to one yarn during twisting so that it is 0.5% to 2.5% longer than the other yarn.

As explained below, a POSITA would have been motivated to combine these references. Ex. 1003, ¶¶83-84.

A. Motivation to Combine

A POSITA would have been motivated to combine Nakayasu with Fritsch's teachings of applying different tension to yarns twisted to form a cord with one yarn being longer than the other. Specifically, a POSITA would have been motivated to alter the tension of Nakayasu's yarn during twisting so that the aramid yarn is 0.9% longer than the nylon yarn, since Fritsch teaches that such a difference provides beneficial improvements to the physical properties of the tire cord. Ex. 1003, ¶¶85-86.

Fritsch teaches a method for creating a cord with an "unbalanced configuration" which "means that at least two yarns [of the cord] have different lengths." *Id.*, ¶19. Fritsch further teaches that an unbalanced configuration can be achieved by changing the tension applied to each yarn during twisting.

A POSITA would be motivated to combine these teachings in view of the benefits described by Fritsch. Ex. 1003, ¶¶86-88. Specifically, Fritsch notes that its method results in a "hybrid cabled cord of polymeric materials having excellent properties at a reduced capital cost and is useful as a tire cord." Ex. 1023, ¶2. Fritsch notes that conventionally, twisting machines are "intended to achieve a balanced tension control in the cabled cord produced which effectively means that the two yarns are pulled off with the same rate and thus equal lengths are incorporated into the cabled cord." *Id.*, ¶24. However, Fritsch's inventors discovered that "modulat[ing] the tension on the individual plies" can result in an "unbalanced configuration" where one yarn is longer than the other when untwisted. This results in a cord with "greater tensile strength retention." *Id.*, ¶27. Fritsch describes the difference in length of the yarns as a Coring level, which is the percentage difference in length of the higher modulus yarn relative to the lower modulus yarn. *Id.*, ¶¶19-20. For example a Coring level of 5% means the higher modulus yarn is 5% longer than the lower modulus yarn. *Id.*

Fritsch provided experimental results that showed an improvement with unbalanced configurations, *i.e.* a non-zero Coring level. Ex. 1003, ¶89. Specifically, Fritsch tested 10 "inventive examples" using PEN (polyethylene napthalate) and PET (polyethylene terephthalate) materials, with Coring level ranges from -15% to 15%, and compared their physical properties to three cords with 0% Coring level. These results are shown in Table 1, reproduced below. *Id.*, ¶40. The table shows that having a positive Coring level results in "a combination of a high breaking strength and a high elongation at break." *Id.*, ¶41. Fritsch notes that the desired combination of "physical properties (breaking strength, elongation at break, energy to break and modulus) can be optimized by an appropriate coring level." *Id.*

TABLE 1

Inv. Ex.	Comp. Ex.	Cord components	Coring level	Breaking Strength (N)	Elongation at Break (%)	LASE at 1.6% (N)	LASE at 3% (N)	Elongation (%) at 45 N
	A	PEN/PEN	0	199.2	10.4	21.4	48.7	2.7
1		PEN/PET	−15%	154	n.d.	n.d.	n.d.	n.d.
2		PEN/PET	−12.2%	154.3	9.3	20.8	45.4	3.1
3		PEN/PET	−9.2%	160.8	10.2	17.5	40.5	3.4
4		PEN/PET	−6.3%	164.7	11.1	16.5	32.8	4.0
5		PEN/PET	−3.2%	170.1	11.4	15.7	33.9	3.9
	B	PEN/PET	0	180.5	12.4	15	32.7	4.1
6		PEN/PET	0.9%	184	12.8	14.6	33.7	4.1
7		PEN/PET	4.5%	184.5	13.8	13.8	30.8	4.3
8		PEN/PET	7.7%	183.5	15.4	13.2	28.6	4.6
9		PEN/PET	13.9%	170.4	16.3	12.8	27.6	4.7
10		PEN/PET	15%	170	n.d.	n.d.	n.d.	n.d.
	C	PET/PET	0	177.7	18.9	12.5	26.2	5.2

Accordingly, a POSITA would have been motivated to use one or more of these Coring levels with Nakayasu to achieve improved physical properties. Ex. 1003, ¶90. In particular, a POSITA would have been motivated to use the Coring level of 0.9%, because it provides a good combination of high Breaking Strength, Elongation at Break, LASE at 1.6% and LASE at 3%. *Id.*, ¶40. Even though Fritsch describes a Coring level of 0.9% for a PEN/PET hybrid cord, a POSITA would have understood that the disclosed benefits would also apply to an aramid/nylon hybrid cord. Ex. 1003, ¶93. First, Fritsch itself contemplates an aramid/nylon hybrid cord as one of its inventive cords. Ex. 1023, cls. 8-9. Second, an aramid/nylon hybrid cord uses material with a higher modulus (aramid) and material with a lower modulus (nylon), which is similar to a PEN/PET hybrid cord, as Fritsch describes PEN as having a higher modulus and PET having a lower modulus. Ex. 1023, ¶¶20-

21. Finally, Fritsch expressly teaches that cords using aramid and nylon are "[p]olymeric yarns useful in the inventive method and product," and expressly states such cords preferably have a coring level between -25% and 25%. *Id.*, ¶29.

Although Fritsch is directed to a cord with Coring level between 3% to 15% (*id.*, ¶9), Fritsch's results still show a benefit with using a Coring level of 0.9%, and thus a POSITA would be motivated to achieve a Coring level of 0.9%. Ex. 1003, ¶91. Obviousness does not require a showing that "a combination is the *best* option, only that it be a *suitable* option." *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023); *see also Honeywell International Inc. v. 3G Licensing S.A.*, 124 F.4th 1345, 1355 (Fed. Cir. 2025) ("[O]bviousness does not require that a particular combination must be the preferred, or the most desirable, combination").

In addition, in view of Fritsch, a POSITA would have considered it obvious to try each of the positive Coring levels described in Fritsch's experimental results. Fritsch provides a finite number of identified, predictable Coring levels, and a POSITA would find it obvious to try at least one of them, including the 0.9% Coring level. Ex. 1003, ¶92.

Furthermore, although Fritsch is directed to altering the tension of an apparatus called a direct cabler, a POSITA would have nevertheless found it obvious to apply Fritsch's teachings to any apparatus for twisting yarn, including ring twisters, as a POSITA would be motivated by the benefits of an "unbalanced configuration" as described in Fritsch regardless of the type of twister used for manufacturing the tire cord. Ex. 1003, ¶94.

A POSITA would have had a reasonable expectation of success in combining the references. Ex. 1003, ¶95. A POSITA would have understood that Fritsch's method of modulating the tensions would have been well-within the skill of an ordinary artisan to implement in the manufacture of tire cords. *Id.* Fritsch also explains that its method is useful for all sorts of yarn materials, including "aramid, nylon-6, nylon-6,6 and nylon-4,6," the same materials disclosed by Nakayasu. Ex. 1023, ¶29. In addition, Fritsch specifically teaches applying an unbalanced configuration of hybrid cord using nylon-6 yarn and aramid yarn or using nylon-6,6 yarn and aramid yarn. Ex. 1023, cls. 8-9. Thus, a POSITA would have expected the combination to yield the predictable result of improving the physical properties of Nakayasu's tire cord. Ex. 1003, ¶95.

Fritsch is analogous art to Nakayasu and the '765 patent, because it is directed to the same field of endeavor of manufacturing cords from twisting strands of yarn. Ex. 1007, Abstract ("The hybrid cord includes a low elastic modulus thread and a high elastic modulus thread which are finally-twisted together"); Ex. 1023, Abstract ("The present invention is directed to a hybrid cabled cord comprising: at least two yarns having different properties and an unbalanced configuration wherein the hybrid cabled cord has improved tensile strength retention."); Ex. 1001, Abstract

("The hybrid tire cord includes a nylon primarily twisted yarn and an aramid primarily twisted yarn, wherein the nylon primarily twisted yarn and the aramid primarily twisted yarn are secondarily twisted together").

B. Claim 1

1. 1[pre]: A hybrid tire cord comprising:

Nakayasu discloses a tire cord made from twisting two primarily twisted yarns of different materials: nylon and aramid, *i.e.* ***a hybrid tire cord***. Ex. 1007, 2:44-2:67 ("[A] pneumatic radial tire comprises … ***the hybrid cord*** comprising a low elastic modulus thread and a high elastic modulus thread"); 3:16 ("[T]he low elastic modulus fiber, ***nylon fibre***"), 5:23-24 ("To form a high elastic modulus thread 21, one or more ***aramid fibers*** are first-twisted together in a certain direction."); Ex. 1003, ¶¶97-98. As discussed below in limitations 1[a], 1[b], and 1[c], Nakayasu discloses a hybrid tire cord made by twisting together an aramid primarily twisted yarn and a nylon primarily twisted yarn.

As discussed above, the '765 patent specification describes a "tire cord" as including either a raw cord or a dip cord. Ex. 1001, 5:35-38. Nakayasu hybrid cord is a ***raw cord*** because it is formed by twisting two threads and is therefore untreated at the time it is formed. Ex. 1007, 5:26:28; Ex. 1003, ¶99.

2. 1[a]: a nylon primarily twisted yarn; and

Nakayasu discloses that "to form a low elastic modulus thread 22 [*i.e.* ***nylon***

primarily twisted yarn], one or more nylon fibers are first-twisted together." Ex. 1007, 5:24-26. The "low elastic modulus thread" is a "primarily twisted yarn" as described in the specification because it is a nylon filament yarn twisted in one direction. Ex. 1003, ¶¶100-01.

3. 1[b]: an aramid primarily twisted yarn,

Nakayasu discloses that the "one or more aramid fibers are first-twisted together in a certain direction" in order "[t]o form a high elastic modulus thread 21," *i.e.* ***aramid primarily twisted yarn***. Ex. 1007, 5:23-24. The "high elastic modulus thread" is a "primarily twisted yarn" as described in the specification because it is an aramid filament yarn twisted in one direction. Ex. 1003, ¶¶102-03.

4. 1[c]: wherein the nylon primarily twisted yarn and the aramid primarily twisted yarn are secondarily twisted together,

Nakayasu teaches a step where high elastic modulus thread 21 (*i.e.* ***aramid primarily twisted yarn***) and the low elastic modulus thread 22 (*i.e.* ***nylon primarily twisted yarn***) are "finally-twisted together … to form a hybrid cord 23," *i.e.* ***secondarily twisted together***. Ex. 1007, 5:23-28; Ex. 1003, ¶¶104-05.

5. 1[d]: if the secondary twist of the hybrid tire cord with a predetermined length were untwisted, a length of the aramid primarily twisted yarn would be 1.005 to 1.025 times a length of the nylon primarily twisted yarn,

Fritsch discloses a cord with an "unbalanced configuration" where one of the cord's yarns is 0.9% longer than the cord's other yarn, *i.e.* ***1.005 to 1.025 times the***

length. As discussed above, a POSITA would have been motivated to combine Fritsch's teachings with Nakayasu. Ex. 1003, ¶¶106-07.

Fritsch teaches that the ratio of the lengths of the yarns is measured using a value called "coring level," which Fritsch discloses can be ***1.005 to 1.025 times longer***. Ex. 1023, ¶19. The "coring level" is measured by "taking a sample of one meter of cabled cord [*i.e.* ***hybrid tire core with a predetermined length***] and ***untwisting*** the cable in order to separate the two yarns which compose it," following which the two yarns "are then ***untwisted*** by the same number of turns as it took to separate the cable, and in the opposite direction, to yield the two yarns in their as-fed state," *i.e.* ***the hybrid tire cord is untwisted***. Ex. 1023, ¶19. The "coring level" is calculated as $Coring = (A - B)/B$ "wherein A is the length of the yarn having the higher modulus," *i.e.* ***the aramid primarily twisted yarn***, and "B is the length of the yarn having the lower modulus," *i.e.* ***the nylon primarily twisted yarn***. *Id.*; Ex. 1003, ¶108.

A Coring level of 0.005 to 0.025, or ***0.5% to 2.5%***, corresponds with the higher modulus yarn being ***1.005 to 1.025 times longer*** than the lower modulus yarn. Ex. 1003, ¶109.

Fritsch teaches Coring levels of 0.5% to 2.5%. Ex. 1003, ¶110. Fritsch mentions that a "[p]referred" Coring level is a "non-zero" value "no greater than about 25% and no less than about -25%," which includes the claimed range. Ex.

1023, ¶29.

For example, in Table 1, one of the "inventive cords" that was tested had a Coring level of 0.9%. Ex. 1023, ¶40. Notably, this cord had a relatively high Breaking Strength of 184 (second highest among the tested cords) and a relatively high Elongation at Break percentage of 12.8%. *Id.* Fritsch notes that it is desirable to balance the two values. *Id.*, ¶41. The desirable breaking strength of this inventive cord is depicted in the below annotated Figure 2, which is a graph of the Coring level of the tested inventive cords against their Breaking Strength. Ex. 1003, ¶111.

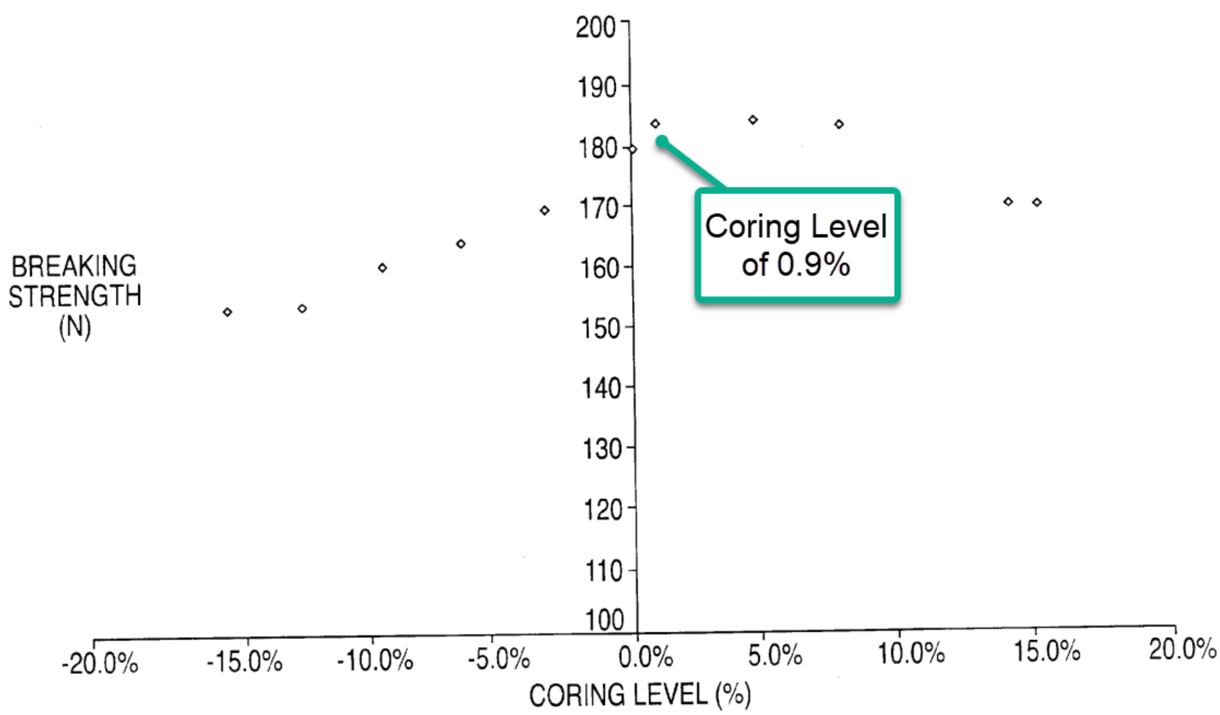


FIG. 2

As discussed above, a POSITA would have been motivated to combine Fritsch's teachings with Nakayasu, including the application of a Coring level of 0.9% to Nakayasu's aramid-nylon hybrid cord.

6. 1[e]: the aramid primarily twisted yarn has a 0.1 to 5% lower twist number than a twist number of the nylon primarily twisted yarn, and

Nakayasu discloses a tire cord embodiment where its ***aramid primarily twisted yarn*** has a ***0.9% lower twist number*** than that of its ***nylon primarily twisted yarn***. Ex. 1003, ¶¶112-13. Nakayasu teaches as a general matter that "rigidity [of the tire cord] can be increased by … decreasing the first-twist of the high elastic modulus thread," *i.e.* ***the aramid primarily twisted*** yarn. Consistent with this teaching, Table 1 of Nakayasu, which "shows the specifications of [nine] test tires," shows that the third tire cord "Ex. A" had an aramid "[h]igh modulus thread" with "42.0" twists per 10 cm (or 420 twists per meter (TPM)) and a nylon "[l]ow modulus thread" with "42.4" twists per 10 cm (or 424 TPM). Ex. 1007, 5:38, 6:21-22, Table 1. 420 TPM is 0.9% lower than 424 TPM. Ex. 1003, ¶113.

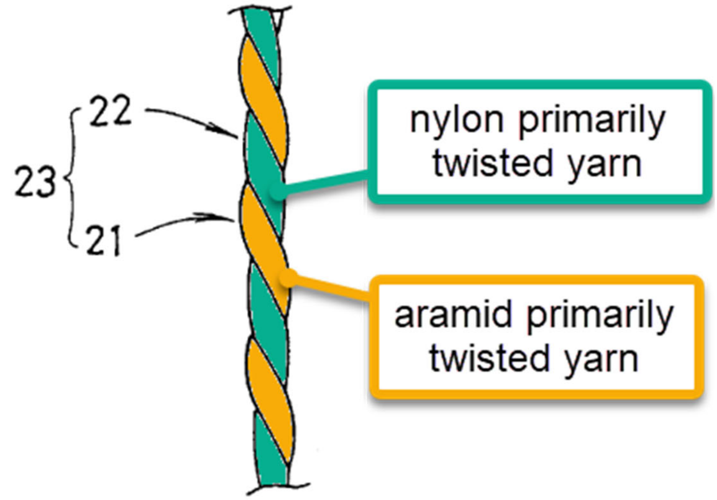
Tire No.	1 Ref. A	2 Ref. B	3 Ex. A
Band belt Code No. Material	1	2	3
High modulus thread	aramid 1000D	aramid 1000D	aramid 1000D
Low modulus thread	nylon 1260D	nylon 840D	nylon 420D
First-twist (T/10 cm)			
High modulus thread	42.0	42.0	42.0
Low modulus thread	24.5	30.0	42.4
Final-twist (T/10 cm)	37.5	42.0	47.8

7. 1[f]: the hybrid tire cord has a merge structure having a partial covering structure.

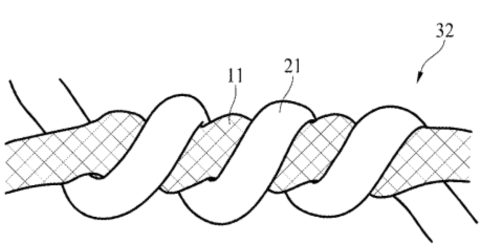
As discussed above, Patent Owner proposes that "merge structure having a partial covering structure" be construed as "a structure where both the nylon and aramid yarns have been twisted together where each yarn partially covers the other." Ex. 1040, 19. Nakayasu discloses this limitation under Patent Owner's construction. Ex. 1003, ¶¶114-15.

As discussed above in limitation 1[c], Nakayasu discloses that the nylon and aramid yarns are "finally-***twisted together*** … to form a hybrid cord." Ex. 1007, 5:23-28. As depicted in Figure 4 of Nakayasu, the yarns are twisted together such that ***each yarn partially covers the other***. Ex. 1003, ¶116.

Fig. 4



Although Nakayasu states that Figure 4 is "an exterior view of hybrid cord No. 2" (Ex. 1007, 4:29), a POSITA would understand that Nakayasu's "Ex. A" hybrid cord would have a similar merge structure, especially because the aramid and nylon yarns of "Ex. A" have a smaller difference in twist numbers (420 TPM and 424 TPM) than "hybrid cord No. 2" (420 TPM and 300 TPM). Ex. 1003, ¶117. As discussed above, applicant had argued that the "merge structure" of Figure 2 provided by applicant is a result of the two yarns having an "identical structure," whereas the "covering structure" of the Figure 1 provided by applicant is a result of the two yarns having different lengths. Ex. 1002, 61-62, 38-40.



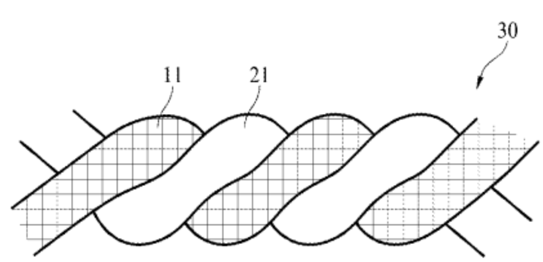
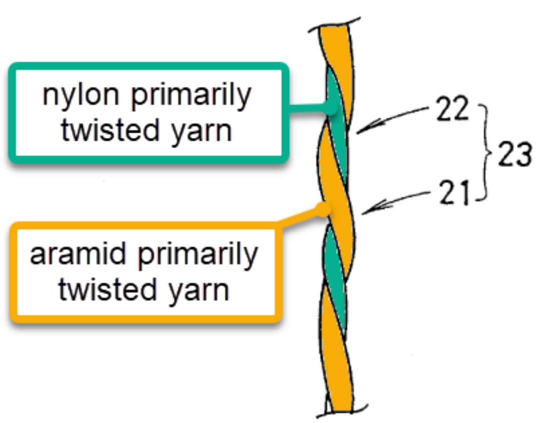


Fig. 1 ("covering structure") (left), Fig. 2 ("merge structure") (right)

Because Nakayasu's "Ex. A" embodiment has yarns that are closer to an identical structure (*i.e.* less difference in TPM) than the "hybrid cord No.2" embodiment, a POSITA would understand that Nakayasu's "Ex. A" embodiment has a structure that more closely resembles the "merge structure" of the applicant's Figure 2. Ex. 1003, ¶118. Indeed, Figure 5 of Nakayasu, which depicts "hybrid cord No. 6," shows a hybrid tire cord that has less of "merge structure" and more of a "covering structure" compared to Figure 4's "hybrid cord No. 2." Ex. 1001, 4:30. Consistent with that depiction, the difference in twists between the aramid and nylon yarns of "hybrid cord No. 6" (420 TPM vs. 100 TPM) is significantly larger than both "hybrid Cord No. 2" (420 TPM vs. 300 TPM) and "Ex. A" (420 TPM vs. 424 TPM); Ex. 1001, Table 1; Ex. 1003, ¶118.

Fig. 5



Similarly, Fritsch's Figure 1 is an illustration of its "inventive hybrid cabled card illustrating a coring level not equal to zero," which depicts a cord having a merge structure with a partial covering structure. Ex. 1003, ¶119. In this figure, yarn 10 "has the higher modulus" (*e.g.* aramid) and thus has a "greater length … than yarn 12," resulting in a positive Coring level. Ex. 1023, ¶21. Consistent with the above, yarn 10 partially covers yarn 12 while the cord still exhibits a merge structure. Ex. 1003, ¶¶119.

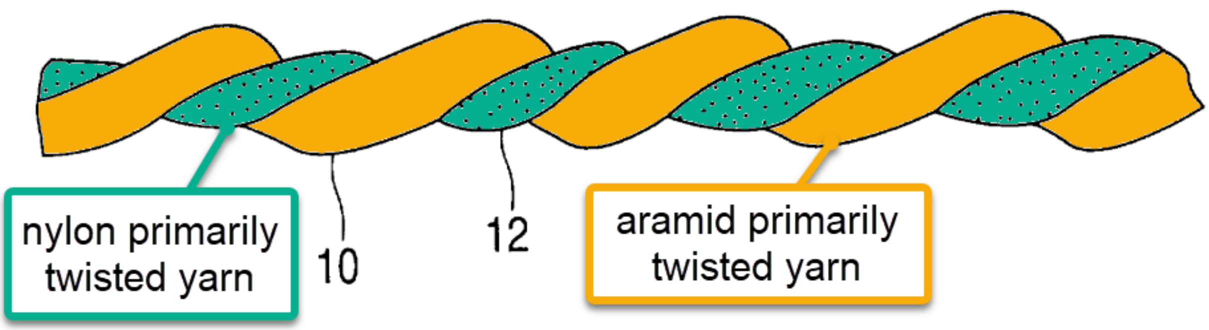


FIG. 1

Regardless, a POSITA would understand that Nakayasu's "Ex. A" embodiment in view of Fritsch has a "merge structure having a partial covering structure" because, as applicant argued during prosecution, such a structure is a result of having the claimed difference in yarn length and twist number. Ex. 1003, ¶120. As discussed above, Nakayasu's "Ex. A" embodiment in view of Fritsch meets the claimed difference.

C. Claim 2

1. 2[pre]: The hybrid tire cord according to claim 1, wherein the nylon primarily twisted yarn has a first twist direction,

Nakayasu discloses that "to form a low elastic modulus thread 22 [*i.e.* ***nylon***

primarily twisted yarn], one or more nylon fibers are ***first-twisted together***." Ex. 1007, 5:24-26. The direction of the twist is a ***first twist direction***. Ex. 1003, ¶¶121-22.

2. 2[a]: the aramid primarily twisted yarn has a second twist direction,

Nakayasu discloses that the "one or more aramid fibers are first-twisted together in a certain direction" in order "[t]o form a high elastic modulus thread 21," *i.e.* ***aramid primarily twisted yarn***. Ex. 1007, 5:23-24. The direction of the twist is a ***second twist direction***. Ex. 1003, ¶¶123-24.

3. 2[b]: the nylon primarily twisted yarn and the aramid primarily twisted yarn are secondarily twisted together in a third twist direction,

Nakayasu teaches a step where high elastic modulus thread 21 (*i.e.* ***aramid primarily twisted yarn***) and the low elastic modulus thread 22 (*i.e.* ***nylon primarily twisted yarn***) are "finally-twisted together … to form a hybrid cord 23," *i.e.* ***secondarily twisted together***. Ex. 1007, 5:23-28. The direction of the twist is a ***third twist direction***. Ex. 1003, ¶¶125-26.

4. 2[c]: the second twist direction is the same as the first twist direction, and

Nakayasu discloses that the "nylon fibers are first-twisted together ***in the same direction*** as the aramid fibers." Ex. 1007, 5:23-24; Ex. 1003, ¶¶127-28.

5. 2[d]: the third twist direction is opposite to the first twist direction.

Nakayasu teaches that the high elastic modulus thread 21 (*i.e.* ***aramid primarily twisted yarn***) and the low elastic modulus thread 22 (*i.e.* ***nylon primarily twisted yarn***) are "finally-twisted together in the reverse direction to the first-twist," *i.e.* ***a third twist direction opposite to the first twist direction***. Ex. 1007, 5:23-28; Ex. 1003, ¶¶129-30.

D. Claim 3: The hybrid tire cord according to claim 1, wherein a weight ratio of the nylon primarily twisted yarn to the aramid primarily twisted yarn is 20:80 to 80:20.

Nakayasu discloses several embodiments that has the claimed weight ratio, including the "Ex. A" embodiment. In particular, in the "Ex. A" embodiment, the ***aramid primarily twisted yarn*** is ***1000 denier***, a denier being a unit of measurement for linear density, specifically grams per 9,000 meters of yarn. Ex. 1007, Table 1, 5:67 ("high elastic modulus thread of ***1000 denier*** aramid fibers"); Ex. 1003, ¶__; Ex. 1003, ¶132. And in that same embodiment, the ***nylon primarily twisted yarn*** is ***420 denier***. Ex. 1007, Table 1, 6:20-22 ("[T]he thickness of the low elastic modulus thread was ***420 denier***").

Tire No.	1 Ref. A	2 Ref. B	3 Ex. A
Band belt Code No. Material	1	2	3
High modulus thread	aramid 1000D	aramid 1000D	aramid 1000D
Low modulus thread	nylon 1260D	nylon 840D	nylon 420D
First-twist (T/10 cm)			
High modulus thread	42.0	42.0	42.0
Low modulus thread	24.5	30.0	42.4
Final-twist (T/10 cm)	37.5	42.0	47.8

A POSITA would understand that the denier of a tire cord using two threads would be the sum of the denier of each thread. Ex. 1003, ¶133. For example, in the Tamura reference, a tire cord made with an aramid fiber with linear density of 1400 dt (decitex, which is grams per 10,000 meters) and a nylon (N66) fiber of 1670 dt had a total linear density of 3070 dt. Ex. 1006, ¶36, Table 1.

For a cord wherein the nylon and aramid yarn are the same length, this results in a nylon to aramid weight ratio of 29.6 to 70.4, which is within the claimed range of ***20:80 to 80:20***. Ex. 1003, ¶134.

$$\%\ weight\ per\ 9{,}000m\ (aramid) = \frac{linear\ density\ denier\ (aramid)}{linear\ density\ denier\ (total\ cord)}\ x\ 100$$

$$\frac{1000\ denier}{1000\ denier + 420\ denier}\ x\ 100 = 70.4\%$$

$$\%\ weight\ per\ 9{,}000m\ (nylon) = \frac{linear\ density\ denier\ (nylon)}{linear\ density\ denier\ (total\ cord)}\ x\ 100$$

$$\frac{420\ denier}{1000\ denier + 420\ denier}\ x\ 100 = 29.6\%$$

However, as discussed in limitation 1[d], it would have been obvious to combine Nakayasu and Fritsch such that the aramid yarn's length is 0.9% longer than the nylon yarn's length when untwisted. Ex. 1003, ¶135. The weight of aramid yarn would therefore be 1.009 times more than the aramid yarn in an embodiment where the yarn lengths are the same. *Id.* For example, for every 9,000 meter of nylon yarn, the tire cord would have 9,081 meters of aramid yarn. Based on the linear density used in "Ex. A," this results in 420 grams of nylon yarn and 1,009 grams of aramid yarn, a weight ratio of 29.4 to 70.6, which is still within the claimed weight-ratio range.

Indeed, for the linear densities of "Ex. A," an aramid yarn that is 1.005 to 1.025 times the length of the nylon yarn will always be within the claimed weight-ratio range. Ex. 1003, ¶136. A 1000 denier aramid yarn that is 1.005 times the length of a 420 denier nylon yarn has a weight-ratio of 29.5 to 70.5, and a 1000 denier aramid yarn that is 1.025 times the length of a 420 denier nylon yarn has a weight-ratio of 29.1 to 70.9.

All of the above weight-ratios fall within the claimed range and therefore disclose this limitation. *See, e.g.*, *UCB, Inc. v. Actavis Labs. UT, Inc.*, 65 F.4th 679, 687 (Fed. Cir. 2023) ("If the prior art discloses a point within the claimed range, the prior art anticipates the claim."); *Pfizer Inc. v. Sanofi Pasteur Inc.*, 94 F.4th 1341, 1347 (Fed. Cir. 2024) ("[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation").

E. Claims 4-6

Claims 4-6 recite the tire cord of claim 1 is further coated with an adhesive agent. Nakayasu teaches that "rigidity can be increased … by providing an extensibility for the hybrid cord through an ***adhesion process and heating process therefore***." Ex. 1007, 3:43-47. A POSITA would understand that an adhesion and heating process involves coating both the aramid and nylon yarns of the raw tire cord by dipping the cord into an adhesive agent solution, and then curing it through heat. Ex. 1003, ¶¶137-38. For example, Fritsch itself teaches a "dip/dry/stretch/dip/relax process" where the second dip uses "Resorcinol Formaldehyde Latex," a known ***adhesive agent solution*** as the '765 patent admits. Ex. 1023, ¶45-49; Ex. 1001, 8:50-52 ("A resorcinol formaldehyde Latex (RFL) solution … can be used as the adhesive agent solution.").

Claims 4-6 further recite various properties of the treated tire cord exhibited when tests are conducted. Ex. 1003, ¶139. The results of such tests are dependent on the structure, materials, and coating of the tire cord. *Id.* Because Nakayasu's tire cord in view of Fritsch has an aramid yarn length of 1.009 longer than the nylon yarn length and the claimed difference in twist numbers, a POSITA would understand that such a tire cord would exhibit the same test results described in the specification for similar values, such as the ’765 patent’s Example 6, which has an aramid yarn 1.01 times longer than nylon yarn. Ex. 1001, col. 11-12, Table 2; Ex. 1003, ¶139. The test results of such a cord meets claims 4-6. *Id.* (strength at break of 13.5, elongation at break of 11.3, shrinkage of 2.1%, disk fatigue of 96%).

Indeed, during prosecution, the examiner found that “[w]ith the same structure, same materials, and same coating, the hybrid cord of the combination would obvious[ly] produce the same test results, no matter the test involved.” Ex. 1002, 63. Not only did the applicant not dispute this statement, the applicant provided test results that were consistent with the examiner’s finding. Ex. 1003, ¶140. Specifically, the applicant provided test results that showed that producing a tire cord embodied by the claims ***even using the “procedure and condition described” in the prior art*** had test results that met claims 4-6. Ex. 1002, 44-45 (showing test results that had strength at break between 8 to 15 g/d, elongation at break between 7 to 15%, disk fatigue greater than 90%, and shrinkage between 1.5 to 2.5%); Ex. 1003, ¶140.

Thus, a POSITA would consider claims 4-6 as obvious properties resulting from a tire cord meeting the claimed limitations of claim 1 and the preamble of claim 4. Ex. 1003, ¶141.

IX. GROUND 2: NAKAYASU AND FRITSCH IN FURTHER VIEW OF TAMURA, CHUNG, YOKOKURA, SHEPHERD, AND ROWAN RENDERS OBVIOUS CLAIMS 4-6

As discussed above, Claims 4-6 recite various test results for the claimed hybrid tire cord. The prior art demonstrates that such test results were already known to be desirable and achievable through routine experimentation and optimization. Such prior art includes Tamura, Chung, Yokokura, Shepherd, and Rowan. As discussed herein, a POSITA would have been motivated to achieve such test results in view of those references. Ex. 1003, ¶¶142-43.

A. Claim 4

1. 4[pre]: The hybrid tire cord according to claim 1, further comprising an adhesive agent coated on the nylon primarily twisted yarn and the aramid primarily twisted yarn,

As discussed above in Ground 1, Nakayasu alone and in view of Fritsch discloses dipping the raw tire cord into an adhesive agent solution, specifically RFL. Ex. 1003, ¶144.

2. 4[a]: wherein strength at break and elongation at break measured by ASTM D885 (2004) are 8.0 to 15.0 g/d and 7 to 15%, respectively, and

Petitioner provides a discussion of the unit "g/d," which stands for "grams per denier," or more accurately "grams-force per denier." A "denier" is a unit of measure for linear mass density of textile fibers, and is the mass in grams of a fiber that is 9,000 meters long. Ex. 1003, ¶146.

The prior art often uses different units of measurement than the claimed "g/d." Some prior art references use Newtons, which is the amount of force on an object with a mass of one kilogram at Earth's gravity. Ex. 1003, ¶147. A Newton is about 101.97 grams-force. *Id.* To convert a measurement in Newtons to g/d, the Newtons must be converted to grams-force and then divided by the linear density of the cord as measured in denier. *Id.* Sometimes a prior art reference only provides the density of the individual yarns for the tire cord. *Id.*, ¶148. Because the yarns are twisted to form a cord, the density of the cord is simply the sum of the density of each yarn. *Id.* Thus, a cord comprising a first yarn with density of 1000 denier and a second yarn with density of 1300 denier would have a total density of 2300 denier. *Id.* Tamura, for example, confirms that a POSITA would understand this calculation of the total linear density of a hybrid tire cord, as it lists the "[t]otal fineness" (*i.e.*the linear density) of its hybrid tire cords as a sum of the linear densities of each individual yarn. Ex. 1006, ¶36, Table 1.

Tamura describes a "composite fiber cord" comprising aramid and nylon yarns, where the elongation at break was 10.5% and the breaking strength was 325 Newtons of force. Ex. 1006, ¶39, Table 3. Tamura discloses that this cord had a "[t]otal fineness" (*i.e.* linear density) of 3070 dt, where "dt" refers to "decitex," and 1 decitex equals 0.9 denier. Ex. 1006, ¶¶34, 36, Table 1; Ex. 1003, ¶149. 3070 decitext is therefore 2,763 denier. Ex. 1003, ¶149. As discussed above, Newtons can be converted to the claimed "g/d" (*i.e.* grams-force per denier) by converting Newtons into grams-force (1 Newton is 101.97 grams-force) and dividing by the denier of the cord. *Id.* This converts to a breaking strength of 12 g/d, which corresponds to the "Strength" of the cord listed in Table 2 of Tamura, and is within the claimed range. *Id.*

Similarly, Chung describes a "hybrid tire cord" comprising the twisting of a nylon filament and an aramid filament, with a breaking strength of "8.0 to 15.0 g/d" and "[e]longation at break of 10 to 20%," both of which are as "measured by ASTM D885." Ex. 1012, 5, cl. 6. Chung also discloses embodiments that fall within the claimed ranges, specifically embodiment 1 (breaking strength of 12.2 g/d and elongation at break of 12.4%) and embodiment 2 (11.5 g/d and 13.4%). Ex. 1012, 8, Table 3; Ex. 1003, ¶150. Although Chung does not specifically disclose that the 2004 version of the ASTM D885 was used, a POSITA would have understood Chung's disclosure of the ASTM D885 standard to refer to the then-recent editions of it—for example, the September 2001, April 2002, November 2002, February 2003, ***October 2004***.[1] EX1003, ¶151. When Chung was first filed with the Korean

[1] A POSITA would have known that the American Society for Testing and Material (ASTM) develops international consensus standards, including model standard test methods for tire cords. EX1003, ¶151 n.2.

Patent Office on June 3, 2005, the 2004 edition of the ASTM D885 was the most recent version. Thus, a POSITA would have understood Chung to disclose ***the 2004 edition***, as claimed. *Id.* Moreover, the 2001-2004 editions of the ASTM D885 standard are substantially the same with respect to the breaking strength and elongation at break test methods. EX1003, ¶¶151-153 (comparing Exs. 1027 through 1030 (2001-2004 versions of ASTM D885)).

Moreover, the claimed breaking strength and elongation at break were obtainable through routine optimization of the prior art and is thus not inventive. EX1003, ¶154; *Merck & Co. Inc. v. Biocraft Lab. Inc.*, 874 F.2d 804, 809 (Fed. Cir. 1989) (claim limitations are not distinguishable over the prior art when the only differences are results reached with routine procedures yielding predictable results); *In re Kulling*, 897 F.2d 1147, 1149 (Fed. Cir. 1990) (claimed amount of wash solution was found unpatentable as a matter of routine optimization in the pertinent art). This is seen in the prior art, where the claimed amounts were achieved by manufacturing various tire cords and testing them. Ex. 1003, ¶154.

A POSITA would have understood that the breaking strength and elongation at break test values disclosed in the above references were desirable and a POSITA would have been motivated to manufacture tire cords that achieved such desirable test results. Ex. 1003, ¶155. Indeed, Fritsch teaches that a "combination of a high breaking strength and a high elongation at break" is desirable, and so is "maximiz[ing]" the breaking strength. Ex. 1023, ¶¶41-42. In addition, a POSITA would have found it obvious to try manufacturing tire cords with such desirable test results. Ex. 1003, ¶155. The above test results are a finite set of identified and predictable results achievable through routine experimentation and optimization. *Id.*

In addition, a POSITA would have had a reasonable expectation of success in achieving such test results. Ex. 1003, ¶156. As shown in the above references, achieving the disclosed breaking strength and elongation at break was a matter of routine experimentation and optimization. *Id.* Moreover, the applicant during prosecution demonstrated the ability to achieve the claimed test results through routine experimentation and optimization. *Id.* During prosecution, applicant presented test results for aramid-nylon hybrid tire cords with the claimed differences in yarn length and twist numbers which exhibited the claimed breaking strength and elongation at break. Ex. 1002, 41-45. The applicant ***admitted*** such tire cords were manufactured using prior art methods. *Id.* Thus, the applicant proved that as long as the tire cords used the claimed materials, were within the claimed differences in yarn length and twist numbers, and were dipped in an adhesive agent solution (all of which as demonstrated above were disclosed or rendered obvious by Nakayasu-Fritsch), achieving the claimed test results was merely a matter of routine experimentation and optimization. Ex. 1003, ¶156. This is especially true when a POSITA would have looked to Fritsch, Tamura, and Chung and have been motivated to achieve such test results. *Id.*

3. 4[b]: a strength maintenance percentage after disk fatigue test conducted by JIS-L 1017 (2008) of Japanese Standard Association (JSA) is 90% or higher.

Although the claims recite the "2008" version of JIS-L 1017, no such version of the standard appears to exist. JIS-L 1017 appears to only have a single version, which was published in 2002. Ex. 1003, ¶158. In addition, in the parallel litigation, Patent Owner has proposed construing "disk fatigue test conducted by JIS-L1017 (2008)" as "disc fatigue test conducted by JIS-L 1017 standard as of the priority date," *i.e.* Patent Owner has construed the term to no longer require the "2008" version of the standard. Ex. 1040, 26. For purposes of this proceeding only, Petitioner interprets this limitation to require use of JIS-L 1017 as published in 2002. Regardless, the two versions of JIS-L1017 available at the time of the patent (1996 and 2002) provide the same "disk fatigue test." Ex. 1003, ¶158; Ex. 1036, 28-29; Ex. 1037, 28-29.

Yokokura discloses the desirability of achieving a ***strength maintenance percentage of at least 90%*** following the disk fatigue test conducted in accordance with JIS-L 1017, and a POSITA would have been motivated to manufacture tire cords to achieve such test results. Ex. 1003, ¶159.

Yokokura teaches a "tire having a reduced weight and improved durability" and "reinforcement cords being para-aramid cords." Ex. 1013, Abstract. According to Yokokura, "[a]fter [a] driving test [on a drum]" *i.e.* ***a disk fatigue test*** "each cord was removed from the corresponding tire and then evaluated for strength in accordance with JIS L 1017," and "[t]he measurement strength was converted into the retention ratio in %." *Id.*, ¶82. One of the embodiments in Yokokura exhibited a "strength retention ratio," *i.e.* ***strength maintenance percentage***, of at least 90%, specifically "Example 3-3" which had a strength maintenance percentage of 98%. Tamura similarly discloses several embodiments with a "[s]trength retention rate" of at least 90%. Ex. 1006, Table 2 (showing embodiments 1 and 3-6 having 90% or 91% strength retention rate). Tamura discloses that such values were calculated "[i]n accordance with JIS L 1017," and then used to measure "force" and the converted to a "strength (g/d)." Ex. 1006, ¶34. The cord was then vulcanized and then "subjected to a bending test," *i.e.* ***a disk fatigue test***. *Id.*, ¶35; Ex. 1003, ¶161. The "strength retention rate" was then calculated by dividing the strength after bending by the strength before bending, multiplied by 100. *Id.*

$$\boldsymbol{Strength\ Retention\ Rate} = \frac{Strength\ after\ bending}{Strength\ before\ bending}\ x\ 100$$

A POSITA would have understood that the strength maintenance percentage disclosed in the above references was desirable and a POSITA would have been motivated to manufacture tire cords that achieved such desirable test results. Ex. 1003, ¶163. Indeed, as Yokokura explains, "[t]he higher the retention ratio is[,] the better the test result is." Ex. 1013, ¶82. Moreover, Kwon explains that if the strength retention rate of a tire cord does not exceed 90%, "the ability to support the tire is reduced due to deterioration of physical properties during driving, resulting in deterioration of driving performance and, in severe cases, tire rupture." Ex. 1021, ¶139; Ex. 1003, ¶163.

In addition, a POSITA would have found it obvious to try manufacturing tire cords with such desirable test results. The above test results are a finite set of identified and predictable results achievable through routine experimentation and optimization. Ex. 1003, ¶164.

Moreover, the claimed strength maintenance ratio was obtainable through routine optimization of the prior art and is thus not inventive. EX1003, ¶162; *Merck*, 874 F.2d 804; *In re Kulling*, 897 F.2d 1147.

In addition, a POSITA would have had a reasonable expectation of success in achieving such test results. As shown in the above references, achieving the disclosed breaking strength and elongation at break was a matter of routine experimentation and optimization. Moreover, the applicant during prosecution demonstrated the ability to achieve the claimed test results through routine experimentation and optimization. During prosecution, applicant presented test results for aramid-nylon hybrid tire cords with the claimed differences in yarn length and twist numbers which exhibited the claimed strength maintenance percentage. Ex. 1002, 41-45. The applicant ***admitted*** such tire cords were manufactured using prior art methods. *Id.* Thus, the applicant proved that as long as the tire cords used the claimed materials, were within the claimed differences in yarn length and twist numbers, and were dipped in an adhesive agent solution (all of which as demonstrated above were disclosed or rendered obvious by Nakayasu-Fritsch), achieving the claimed test results was merely a matter of routine experimentation and optimization. Ex. 1003, ¶165. This is especially true when a POSITA would have looked to Yokokura and Tamura and have been motivated to achieve such test results.

B. Claim 5: The hybrid tire cord according to claim 4, wherein the hybrid tire cord has 3% LASE, 5% LASE, and 7% LASE measured by ASTM D885 (2004), of 0.8 to 2.0 g/d, 1.5 to 4.0 g/d, and 3.0 to 6.0 g/d, respectively.

This claim recites various measurements of "LASE," which is an abbreviation for "load at specified elongation." LASE refers to the amount of force necessary to elongate the hybrid tire cord to the specified amount. Ex. 1003, ¶¶166-67. In other words, this claim requires that the hybrid cord be elongated by 3% when applying 0.8 to 2.0 g/d, 5% when applying 1.5 to 4.0 g/d, and 7% when applying 3.0 to 6.0 g/d.

Several references describe 3%, 5%, and/or 7% LASE falling within the claimed ranges. Ex. 1003, ¶168.

For example, Figure 2 of Shepherd charts "load (stress) grams/denier" against "% elongation (strain)" for various tire cords, including an aramid/nylon tire cord.

Ex. 1008, Fig. 2. As shown below in the annotated Figure 2, at 3%, 5%, and 7% elongation, the load values are respectively, about 1.2 g/d, a little more than 2 g/d, and a little more than 3 g/d, all of which fall within the claimed ranges. Ex. 1003, ¶169.

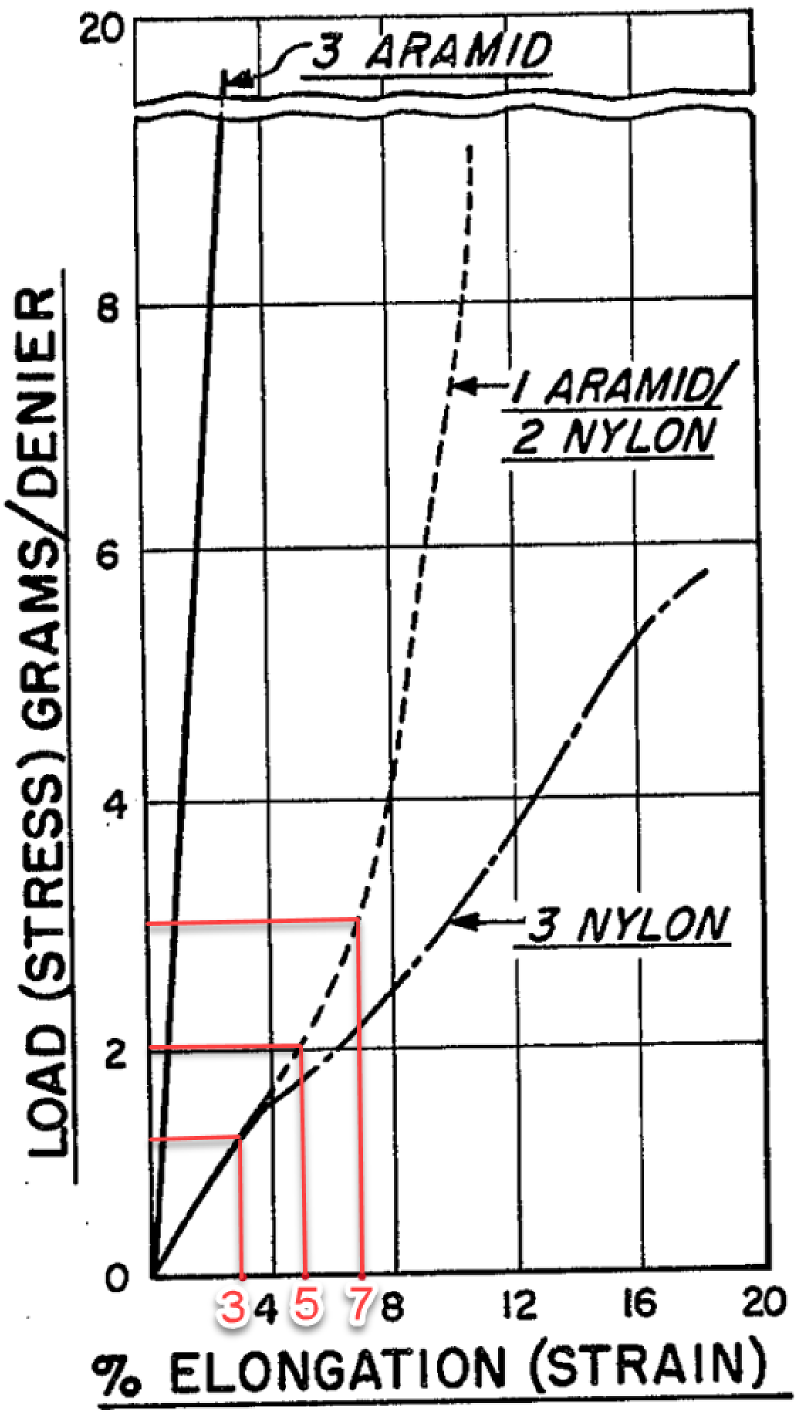
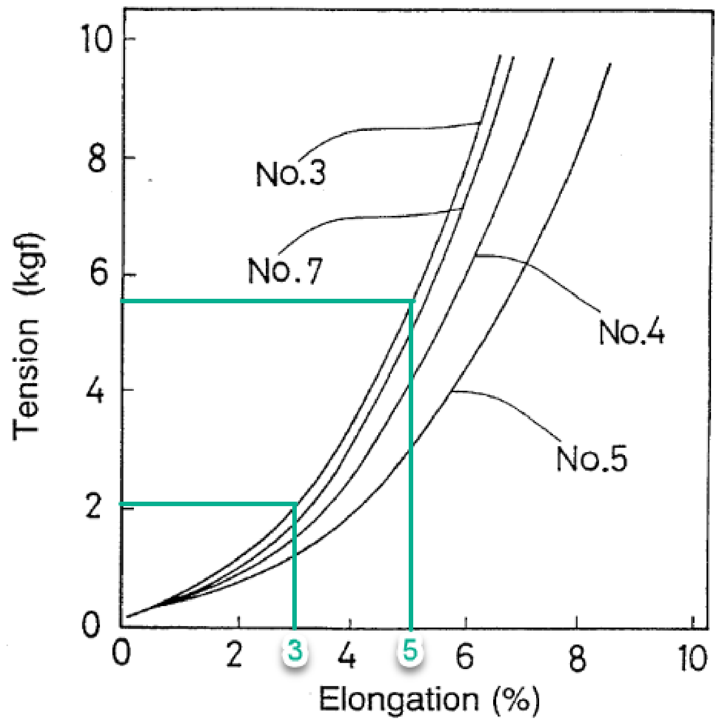

3 ARAMID
1 ARAMID/
2 NYLON
3 NYLON
LOAD (STRESS) GRAMS/DENIER
20
8
6
4
2
0
3
4
5
7
8
12
16
20
% ELONGATION (STRAIN)

FIG. 2

Shepherd also describes measuring 7% LASE for several embodiments of aramid-nylon hybrid tire cords, many of which resulted in loads within the claimed range. Ex. 1008, col. 7-8, Table 3. These cords used 1260 denier nylon and 1500 denier aramid, for a total of 2760 denier. *Id.*, 6:4-6; Ex. 1003, ¶170. Shepherd recorded its loads using "lbs," *i.e.* pounds, which equal 453.6 grams-force. Shepherd found 7% LASE values of 25.2 lbs (equivalent to 4.1 g/d), 21.2 lbs (3.5 g/d), 22.9 lbs (3.8 g/d), 17.8 lbs (2.9 g/d) and 28.1 lbs (4.6 g/d). Ex. 1008, col. 7-8, Table 3. Four of the five values are within the claimed range for 7% LASE. Ex. 1003, ¶170.

Similarly, Nakayasu describes the force at various percentages of elongation, measured in "kgf," which is kilograms-force and equal to 1,000 grams-force. Ex. 1003, ¶171. Nakayasu describes that its "Ex. A" embodiment, which uses an aramid yarn of 1000 denier and a nylon yarn of 420 denier, for a total density of 1420 denier, had a load of 1.1 kgf (equivalent to 0.77 g/d) at 2% elongation and 8.0 kgf (5.6 g/d) at 6% elongation. Ex. 1007, col. 7-8, Table 1; Ex. 1003, ¶171. Figure 2, which reflects these values, also shows that the "Ex. A" embodiment" (*i.e.* "No. 3") had a load of about 2 kgf (1.4 g/d) at 3% elongation, and about 5.5 kgf (3.9 g/d) at 5% elongation. Ex. 1003, ¶171. These values are within the claimed ranges.

Fig. 2



Tamura provides the load values for 3%, 4% and 4.5% elongation, which are consistent with the claimed ranges. Specifically, Tamura's Embodiment 1, which has a total density of 3070 dt (*i.e.* 2,763 denier) (*see* Ex. 1006, Table 1, column "Total fineness (dt)"), had a load of 44 Newtons (equivalent to 1.6 g/d) at 3% elongation, 55 Newtons (2.0 g/d) at 4% elongation, and 66 Newtons (2.4 g/d) at 4.5% elongation. Ex. 1003, ¶172. Given the progression of these values, a POSITA would understand that 5% elongation would be within the claimed range of 2.4 g/d through 4.0 g/d. *Id.*

Fritsch provides loads at 1.6%, 3% and 4.1% elongation for its tire cord embodiment that had a Coring level of 0.9%. Ex. 1023, ¶40, Table 1. The yarns of that tire cord each had a density of 1300 denier, for a total of 2600 denier. *Id.*, ¶39. Fritsch discloses a load of 14.6 Newtons (0.57 g/d) at 1.6% elongation, 33.7 Newtons (1.3 g/d) at 3% elongation, and 45 Newtons (1.8 g/d) at 4.1% elongation. *Id.*, ¶40, Table 1; Ex. 1003, ¶173. These values fall within and are consistent with the claimed ranges for 3% LASE and 5% LASE.

A summary of the disclosed LASE values from the prior art is provided below. Ex. 1003, ¶174. The claimed ranges are, once again, 3% LASE of 0.8 to 2.0 g/d, 5% LASE of 1.5 to 4.0 g/d, and 7% LASE of 3.0 to 6.0 g/d.

Shepherd	3% LASE: 1.2 g/d 5% LASE: 2 g/d 7% LASE: 3 g/d, 4.1 g/d, 3.5 g/d, 3.8 g/d, 4.6 g/d
Nakayasu	2% LASE: 0.77 g/d 3% LASE: 1.4 g/d 5% LASE: 3.9 g/d 6% LASE: 5.6 g/d
Tamura	3% LASE: 1.6 g/d 4% LASE: 2 g/d 4.5% LASE: 2.4 g/d
Fritsch	1.6% LASE: 0.57 g/d 3% LASE: 1.3 g/d

	4.1% LASE: 1.8 g/d

In addition, a POSITA would have found it obvious to use ASTM D885 (2004) ("D885-04") to measure LASE. Ex. 1003, ¶175. A POSITA would have understood that ASTM D885 was a conventional industry standard for measuring LASE. Indeed, Fritsch teaches that its LASE values were "determined according to ASTM D885M-94: Standard Test Methods for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns Made From Manufactured Organic-Base Fibers." Ex. 1023, ¶35. Similarly, Chung teaches that "[t]ensile strength," *i.e.* ***load***, and "[e]longation at break" *i.e.* ***load***, are measured by ASTM D885, and therefore a POSITA would have understood to use ASTM D885 to likewise determine LASE given that ASTM D885 measures LASE by measuring load during the breaking strength test. Ex. 1003, ¶175. As Dr. Rust explains, there was no material difference between how ASTM D885 measures LASE between 1994 (when D885M-94 was published) and the claimed 2004 version. Ex. 1003, ¶¶175-180; Ex. 1033, 8, 21-22;[2]

[2] Exhibit 1033 includes D885-94 and D885M-95, but not D885M-94. D885M is simply the SI equivalent of D885, and therefore, as Dr. Rust explains, D885M-94 would be identical to D885-94 besides conversion of the units. Ex. 1003, ¶180.

Ex. 1030, 7-9. In sum, D885 specifies that LASE is calculated by determining the load at various percentages of elongation during the breaking strength test. *Id.* The breaking strength test (as discussed above for claim 4) is substantively the same from D885M-94 to D885-04. *Id.* Dr. Rust notes that D885M-95 (the standard published a year after the D885M-94 standard disclosed in Fritsch) introduced a higher applied pretension (20 nM/tex) for the Breaking Strength test for aramid fibers, though maintained the same pretension for all other fibers (5 nM/tex). *Id.*; Ex. 1033, 21-22. Dr. Rust explains that a POSITA would use the lower pretension for a hybrid aramid-nylon cord given nylon's lower modulus. *Id.*

A POSITA would have understood that the LASE values disclosed in the above references were desirable and a POSITA would have been motivated to manufacture tire cords that achieved such desirable test results. Ex. 1003, ¶182. Indeed, Fritsch explains that it is desirable to have "a combination of a high breaking strength and a high elongation at break," which a POSITA would understand to correspond with the relatively high LASE values disclosed in the above references. Ex. 1023, ¶41. Similarly, Nakayasu describes that its LASE values provide a "suitabl[e] … balance." Ex. 1007, 3:21-22. Shepherd describes that its LASE values for its aramid-nylon hybrid tire cord provides desirable "intermediary elongation." Ex. 1008, 4:63-5:4.

In addition, a POSITA would have found it obvious to try manufacturing tire cords with such desirable test results. The above test results are a finite set of identified and predictable results achievable through routine experimentation and optimization. Ex. 1003, ¶183.

Moreover, the claimed LASE values were obtainable through routine optimization of the prior art and is thus not inventive. Ex. 1003, 181; *Merck*, 874 F.2d 804; *In re Kulling*, 897 F.2d 1147.

In addition, a POSITA would have had a reasonable expectation of success in achieving such test results. As shown in the above references, achieving the disclosed LASE values was a matter of routine experimentation and optimization. And consistent with the applicant's test results shown during prosecution, a POSITA would have understood that as long as the tire cords used the claimed materials, were within the claimed differences in yarn length and twist numbers, and were dipped in an adhesive agent solution (all of which as demonstrated above were disclosed or rendered obvious by Nakayasu-Fritsch), achieving the claimed test results was merely a matter of routine experimentation and optimization. Ex. 1003, ¶184. This is especially true when a POSITA would have looked to Shepherd, Nakayasu, Tamura, and Fritsch and have been motivated to achieve such test results.

C. Claim 6

1. 6[pre]: The hybrid tire cord according to claim 5, wherein the hybrid tire cord has a shrinkage of 1.5 to 2.5%,

Several references in the art describes a shrinkage of 1.5 to 2.5%. Ex. 1003,

¶¶185-86. For example, Tamura describes several aramid-nylon tire cord embodiments that had a shrinkage between 2.0 to 2.5%, as shown below. Ex. 1006, ¶37, Table 2.

		Properties of heat-treated adhe		
		Force (N/piece)	Elongation at breakage (%)	Dry heat shrinkage rate (%)
Comparative Example	1	216	21.0	5.8
	2	216	17.7	6.1
Embodiment	1	325	10.5	2.5
	2	326	8.5	2.4
	3	328	10.0	2.6
	4	364	10.7	3.0
	5	390	11.5	3.2
	6	556	7.0	2.0
	7	581	8.6	2.1
	8	539	8.6	2.1
	9	615	8.8	2.0

Chung discloses hybrid tire cords with "a dry heat shrinkage of 2.0 to 5.0%," which falls within the claimed range. Ex. 1012, 5; Ex. 1003, ¶187; *In re Wertheim*, 541 F.2d 257, 267 (CCPA 1976) ("Of course, the disclosure in the prior art of any value within a claimed range is an anticipation of the claimed range."); *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311 (Fed. Cir 2006) ("Where a claimed range overlaps with a range disclosed in the prior art, there is a presumption of obviousness," which only "can be rebutted if it can be shown that the prior art teaches away from the claimed range, or the claimed range produces new and unexpected results.").

In addition, Chung discloses that embodiment 1 has a dry heat shrinkage of 2.6%, which is so close that prima facie one skilled in the art would have expected the cord to have the same properties as cords with dry heat shrinkages falling within the 1.5-2.5% range. Ex. 1012, 9; Ex. 1003, ¶187. *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 783 (Fed. Cir. 1985) (upholding a rejection of a claim directed to an alloy having 0.8% nickel, 0.3% molybdenum as obvious over a reference disclosing alloys of 0.75% nickel, 0.25% molybdenum, 0.94% nickel, and 0.31% molybdenum because "[t]he proportions are so close that prima facie one skilled in the art would have expected them to have the same properties.").

Rowan also discloses treated hybrid tire cords with dry heat shrinkage between 1.5% and 2.5%, as shown in the below table. Ex. 1015, col. 11, Table II; Ex. 1003, ¶188.

TABLE II

Treated Cord Properties

Run No.	Tensile Strength (N)	Shrinkage @ 177° C., 2 mins. (%)	Elongation at Break (%)	H-Adhesion (N)
1	180	1.6	14.5	135
2	179.6	2.3	16.3	117
3	180.3	1.8	16.1	112
4	180.6	1.5	16.0	109

A POSITA would have understood that the relatively low shrinkage disclosed in the above references was desirable and a POSITA would have been motivated to manufacture tire cords that achieved such desirable test results. Ex. 1003, ¶190. Indeed, Shepherd describes that "low total shrinkage factor" is "highly beneficial." Ex. 1008, 1:47-53. Rowan further explains that "dimensional stability means the ability of a textile material to resist shrinkage during heating," which a POSITA would understand indicates the desirability of a low shrinkage value. Ex. 1015, ¶34.

In addition, a POSITA would have found it obvious to try manufacturing tire cords with such desirable test results. The above test results are a finite set of identified and predictable results achievable through routine experimentation and optimization. Ex. 1003, ¶191.

Moreover, the claimed shrinkage rate was obtainable through routine optimization of the prior art and is thus not inventive. Ex. 1003, ¶189; *Merck*, 874 F.2d 804; *In re Kulling*, 897 F.2d 1147.

In addition, a POSITA would have had a reasonable expectation of success in achieving such test results. As shown in the above references, achieving the disclosed shrinkage rate was a matter of routine experimentation and optimization. Moreover, the applicant during prosecution demonstrated the ability to achieve the claimed test results through routine experimentation and optimization. During prosecution, applicant presented test results for aramid-nylon hybrid tire cords with the claimed differences in yarn length and twist numbers which exhibited the claimed shrinkage rate. Ex. 1002, 41-45. The applicant ***admitted*** such tire cords were manufactured using prior art methods. *Id.* Thus, the applicant proved that as long as the tire cords used the claimed materials, were within the claimed differences in yarn length and twist numbers, and were dipped in an adhesive agent solution (all of which as demonstrated above were disclosed or rendered obvious by Nakayasu-Fritsch), achieving the claimed test results was merely a matter of routine experimentation and optimization. Ex. 1003, ¶192. This is especially true when a POSITA would have looked to Tamura, Chung, and Rowan and have been motivated to achieve such test results.

2. 6[a]: wherein the shrinkage is measured under a primary load of 0.01 g/denier at 180 ° C. for 2 minutes.

Chung discloses that its hybrid tire cord has "physical properties" of "a dry heat shrinkage of 2.0 to 5.0% as measured at an initial load of 0.01 g/De' for 2 minutes at 180°C," which discloses the exact same parameters as this limitation. Ex. 1012, 6; Ex. 1003, ¶¶193-94.

Rowan discloses that its shrinkage was "determined under a tension of 0.05 grams per decitex (g/dtex) or 2 minutes at 177° C. in a closed Testrite oven in accordance with the ASTM method." Ex. 1015, ¶34. 0.05 g/dtex is 0.045 g/d. Fritsch used similar conditions of "177° C. for 2 mins," though applied "0.5 gms/dtex pretension." Ex. 1023, 10:61-63. These parameters are close enough to the claimed parameters that one skilled in the art would have expected the cord to have dry heat shrinkages similarly falling within the 1.5-2.5% range when using the claimed parameters. Ex. 1003, ¶195; *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 783 (Fed. Cir. 1985) (upholding a rejection of a claim directed to an alloy having 0.8% nickel, 0.3% molybdenum as obvious over a reference disclosing alloys of 0.75% nickel, 0.25% molybdenum, 0.94% nickel, and 0.31% molybdenum because "[t]he proportions are so close that prima facie one skilled in the art would have expected them to have the same properties.").

In addition, a POSITA would have found it obvious to use Chung's dry heat shrinkage testing parameters to achieve the desired shrinkage rates disclosed in the prior art. A POSITA would understand that Chung's testing parameters is standard parameters for testing shrinkage, and would further understand that the disclose shrinkage rates in the prior art were suitably low values that would be desirable to achieve using Chung's testing parameters. Ex. 1003, ¶196. Moreover, Chung's testing parameters is a discrete and identified, predictable solution, with a reasonable expectation of success, as Chung explicitly describes that using its testing parameters on aramid-nylon hybrid tire cords should achieve a 2.0-5.0% shrinkage rate, which includes part of the claimed range. *Id.* Thus, a POSITA would have looked to Chung's testing parameters to determine whether Nakayasu-Fritsch tire cord would achieve the relatively low shrinkage rate described by Chung.

X. 35 U.S.C. § 325(D) SUPPORTS INSTITUTION

The same or substantially the same prior art or arguments were ***not*** previously were presented to the Office. None of the references relied on were considered or cited, except Shepherd, which this Petition only uses as one of the several secondary references rendering obvious claim 4. Furthermore, applicant never disputed the examiner's use of Shepherd.

XI. *FINTIV* SUPPORTS INSTITUTION

The Board balances six factors in considering discretionary denial under 35 U.S.C. § 314(a) when parallel litigation exists. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential). Here, the factors ("*Fintiv* factors") favor institution.

Factor 1—potential stay of the district court litigation—is neutral because no party has requested a stay. *VMWare, Inc. v. Intellectual Ventures I LLC*, IPR2020-00470, Paper 13 (PTAB Aug. 18, 2020), at 17 (finding in the absence of a stay motion that this factor "does not weigh for or against discretionary denial").

Factor 2—district court trial date and the Board's statutory deadline—should be considered neutral. The earliest estimated trial date for the district court litigation is far in the future as jury selection is not set to begin until at least February 3, 2026, which is 6 months before the estimated date for the Board's Final Written Decision. Because much will change in one year, the current trial date does not support denial.

See Dish Network v. Broadband iTV, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) ("We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time"). In addition, even if the Board is inclined to weigh this factor in favor of denial, the Board has frequently found that other factors outweigh this factor, especially for a short difference of 5 months. *T-Mobile USA, Inc. et al. v. Cobblestone Wireless LLC*, IPR2024-00137, Paper 15 (PTAB May 15, 2024) (finding an eight month difference weighs in favor of denial, but that it was outweighed by the compelling merits of the petition).

Factor 3—investment in the district court proceedings—weighs heavily against discretionary denial. The associated district court case is still in the very early stages of litigation: discovery is still in the early stages, the Defendants served their invalidity contentions on December 13, 2024, and Claim Construction hearing is not scheduled until May 12, 2025. Moreover, a claim construction order likely will not issue prior to the PTAB's projected institution decision date. Accordingly, the district court will not invest significant resources or issue substantive orders related to the challenged patent prior to the issuance of an institution decision. *See Fintiv*, IPR2020-00019, Paper 11, at 9-12. Regardless, Petitioner diligently prepared and filed this Petition well before the statutory deadline, which weighs against denying institution.

Factor 4—overlap in the parallel proceedings—is neutral as all the challenged claims are also asserted in the district court litigation.

Factor 5—overlapping parties—is neutral as it is "far from an unusual circumstance that a petitioner in *inter partes* review and a defendant in a parallel district court proceeding are the same." *Sand*, IPR2019-01393, Paper 24, at 12-13.

Factor 6—other considerations—weighs against discretionary denial. As explained, the merits of the Petition are strong, and the Challenged Claims are invalid. For example, none of the grounds asserted herein were previously considered by either the Office or the district courts. *Cf. Comcast Cable Commn's, LLC v. Rovi Guides, Inc*., IPR2019-00231, Paper 14 at 11 (PTAB May 20, 2019) (obviousness challenges not "previously considered by the Office or any court" weigh in favor of not denying institution). Moreover, the '765 patent is currently asserted in a district court case. Institution of this IPR provides the opportunity for narrowing and simplifying the litigations for the district court.

Compelling Merits—discretionary denial is also not warranted because this petition presents compelling evidence of unpatentability. As discussed above, the '765 patent concedes that nylon-aramid hybrid reinforcement cords were widespread and well-known in the art. *See supra* § I. The patent purports only to have the aramid yarn be twisted less and have a slightly longer length than the nylon yarn.

But the claimed properties are clearly taught and invalidated by the prior art discussed above.

Accordingly, the Board should decline to exercise its discretion under *Fintiv* and institute trial.

XII. MANDATORY NOTICES

A. Real Party-in-Interest

The real parties-in-interest for Petitioner is HS Hyosung Advanced Materials Corp. and Hyosung USA, Inc.

B. Related Matters

Kolon Industries, Inc. v. Hyosung Advanced Materials Corp. and Hyosung USA, Inc., No. 8:24-cv-00415 (C.D. Cal.).

C. Counsel and Service Information

Electronic service may be made on the email addresses of counsel identified below and in the accompanying Power of Attorney.

Lead Counsel	Backup Counsel
James M. Glass (Reg. No. 46729) jimglass@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 51 Madison Avenue, 22nd Floor New York, NY 10010 Tel: (212) 849-7000	Quincy Lu (Reg. No 76954) quincylu@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 1109 First Avenue, Suite 210 Seattle, WA 98101 Tel: (206) 905-7000 Fax: (206) 905-7100

D. Payment of Fees

The Office is authorized to charge the fee required for this Petition (and any additional fees) to Deposit Account No. 50-5708.

XIII. CONCLUSION

For the reasons above, *inter partes* review is requested.

Date: February 27, 2025

Respectfully submitted,

By: /s/ *James M. Glass*
James M. Glass

Counsel for Petitioner

CERTIFICATION UNDER 37 C.F.R. § 42.24

Under the provisions of 37 C.F.R. § 42.24, the undersigned hereby certifies that the word count for the foregoing Petition for *inter partes* review (excluding the table of contents, table of authorities, mandatory notices, certificate of service or word count, and appendix of exhibits or claim listing) totals 12,788 words, which is within the word limit allowed under 37 C.F.R. § 42.24(a)(i).

Date: February 27, 2025

/s/ James Glass
James Glass (Reg. No. 46729)

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e), 42.105(a), the undersigned hereby certifies service on the PO of a copy of this Petition and its respective exhibits at the official correspondence address for the attorneys of record for the ’765 patent as shown in USPTO PAIR via FedEx:

SUGHRUE MION, PLLC
2000 PENNSYLVANIA AVENUE, N.W.
SUITE 9000
WASHINGTON, DC 20006
UNITED STATES

Courtesy copies were also sent via electronic mail to the parties' counsel of record in the related district court proceeding, including Patent Owner’s:

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Date: February 27, 2025

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