

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FUYAO GLASS INDUSTRY GROUP CO., LTD.,
Petitioner,

v.

SAINT-GOBAIN GLASS FRANCE,
Patent Owner.

Case IPR2026-00462
Patent 11,001,037 B2

DECLARATION OF DR. STEVEN A. CARLSON
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S.
PATENT NO. 11,001,037 B2

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PETITIONER'S EXHIBIT LIST

Exhibit	Shorthand	Description
1001	'037 Patent	U.S. Patent No. 11,001,037 B2
1002	Carlson	Declaration of Steven A. Carlson, Ph.D.
1003	Carlson CV	Curriculum Vitae of Steven A. Carlson, Ph.D.
1004	Coster	U.S. Patent Pub. No. 2004/0219368 A1
1005	Manz	U.S. Patent Pub. No. 2016/0002099 A1
1006	Boote	U.S. Patent No. 8,405,901 B2
1007		E.P. Patent Pub. No. 2090428 A1
1008	Fardel	Certified Translation of E.P. Patent Pub. No. 2090428 A1
1009		Certification of Jacqueline Yorke
1010	Finley	E.P. Patent Pub. No. 0336257 B1
1011	Barton-246	U.S. Patent No. 7,943,246 B2
1012	Barton-001	U.S. Patent Pub. No. 2010/0190001 A1

I. INTRODUCTION

1. My name is Dr. Steven A. Carlson. I am over the age of twenty-one (21) years, of sound mind, and capable of making the statements set forth in this Declaration. I am competent to testify about the matters set forth herein. All the facts and statements contained herein are within my personal knowledge, and they are, in all things, true and correct.

2. I submit this Declaration in support of the Petition for *Inter Partes* Review of claims 1–20 of U.S. Patent No. 11,001,037 B2 under 35 U.S.C. § 312.

3. I have been retained by Fuyao Glass Industry Group Co., Ltd. (“Petitioner” or “Fuyao”) to provide my expert opinions regarding U.S. Patent No. 11,001,037 B2 (the “’037 Patent,” Ex. 1001). More specifically, I have been asked to give my opinion regarding the comparison of the ’037 Patent claims to certain prior patents and publications. I am being compensated for my work in this matter. My compensation in no way depends upon the outcome of this proceeding.

4. I have been asked to consider what a person of ordinary skill in the art (“POSITA”) at the time of the invention (“TOI”) of the ’037 Patent would have understood about the issues I address below. I have been asked to assume by counsel for Fuyao that the TOI was December 5, 2017.

II. QUALIFICATIONS AND BACKGROUND INFORMATION

5. My qualifications for presenting the opinions in this Declaration are set forth in my curriculum vitae, a copy of which is submitted concurrently with this Declaration (Ex. 1003).

6. I have more than 35 years of experience as a technical director and 7 years of experience as a technical marketing director for many coated products and their applications, including for glass fiber optical communications, solar control and high security films for application to various glass windows, curable porous membranes comprising aluminum oxide for lithium battery separators, digital imaging products with silicon dioxide pigment-containing coatings, data storage products of iron oxide coatings, laser imaging products, and specialty polymers and chemicals.

7. After graduating with a B.S. in chemistry from Principia College, I received a Ph.D. in organic chemistry from MIT in 1969.

8. My initial work in coated products covered the periods of 1969-1973 and 1975-1982 where I worked with various curable coatings. This included the commercial development of crosslinking melamine formaldehyde coating formulations for drafting films and of radiation-curable coatings for no wax floor tiles.

9. After 7 years of work in Silicon Valley on iron oxide pigment-based data storage magnetic coatings and then 7 years of work in coated imaging product development and marketing including silicon dioxide-based coatings for digital imaging, I spent 5 years developing advanced lithium metal batteries where I worked extensively with aluminum oxide pigments for use in porous battery separators.

10. In August 2000, I founded Optodot Corporation. As the name of the company suggests, Optodot was started to make optical products based on the unique properties of stable organic free radicals where the free radical electron is symbolized in chemistry by a single dot on an atom of the molecule.

11. The primary application for this technology was in glass fiber optical communications as optical switching components and as very high index of refraction (very high values of 3 to 4 at the approximately 1300 to 1600 nm wavelengths of the optical signals) materials in the cladding or in the protective coating on the cladding of the glass fibers. This very high index of refraction property is very useful for reducing signal loss and for optical switching.

12. Another area of application was in coated plastic films with almost no visible color and high infrared reflection due to the very high index of refraction, for application to conventional windows for solar control and for application to special anti-ballistic and anti-surveillance glass windows for increased blocking in the near infrared of any outside sensors trying to pick up information.

13. The main market for these anti-surveillance films, which often used special glass materials, is in highly secretive U.S. government projects.

14. From my years of work on advanced fiber glass-based and glass window-based products starting in 2000, I am familiar with glass compositions and manufacturing, including for glass fibers.

15. From this work and from most of my other work, I have considerable experience in tensile strength, modulus, and coefficient of thermal expansion testing.

16. Also, I have worked extensively in developing compositions or formulations that involve silicon dioxide, aluminum oxide, and curable materials.

17. I was deposed in connection with two infringement litigation cases on behalf of Presstek, Inc. The first case was Presstek v. Creo in Civil Action No. 05-CV-65-PB. The second case was Presstek v. VIM in ITC case No. 337-TA-636 at which I also provided court testimony. This case resulted in an ITC final decision in favor of Presstek.

18. In addition, I was deposed in connection with an infringement litigation case involving the detection by fluorescence hardware of living biological particles brought by TSI against Azbil BioVigilant. Specifically, I was retained by Azbil BioVigilant as their expert witness for both validity and infringement. The final decision in this case was in favor of Azbil BioVigilant.

III. BASIS FOR OPINIONS

19. My opinions are based on my education, training, and experience, as well as items that I reviewed to prepare my opinions, including the '037 Patent and at least the documents listed in the table at the beginning of this Declaration.

IV. LEGAL CONSIDERATIONS

20. I am not a lawyer and I offer no legal opinions. For the purposes of this Declaration, I have been informed by counsel for Fuyao about certain aspects of the law that are relevant to my analysis, as summarized below.

21. My opinions address what would have been logical to a POSITA at the TOI, given the state of the relevant art, the knowledge and skill that a POSITA would have had, the teachings of the references discussed below, how a POSITA would have understood those teachings, and the predictability of the systems discussed below, including in the modified forms I discuss below. My opinions also address whether a POSITA would have had a reasonable expectation of the modified systems below successfully yielding the results discussed below.

22. I understand that a POSITA is a hypothetical person. He is not a genius. He thinks along the lines of conventional wisdom. I understand that a POSITA is also a person of ordinary creativity, not an automaton. Section V, below, includes qualifications of a POSITA. I also understand that, in determining who would qualify as a POSITA, it is appropriate to consider criteria such as: (a) the type of

problems encountered in the art; (b) prior art solutions to those problems; (c) the rapidity with which innovations are made; (d) the sophistication of the technology; and (e) the education level of active workers in the field.

23. I understand that a claim term is given the meaning that the term would have to a POSITA at the TOI, which generally is the ordinary and customary meaning of the term. I further understand that the ordinary and customary meaning of a term may be evidenced by a variety of sources, including the words of the claims themselves, the specification, the prosecution history, and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art.

V. LEVEL OF ORDINARY SKILL IN THE ART

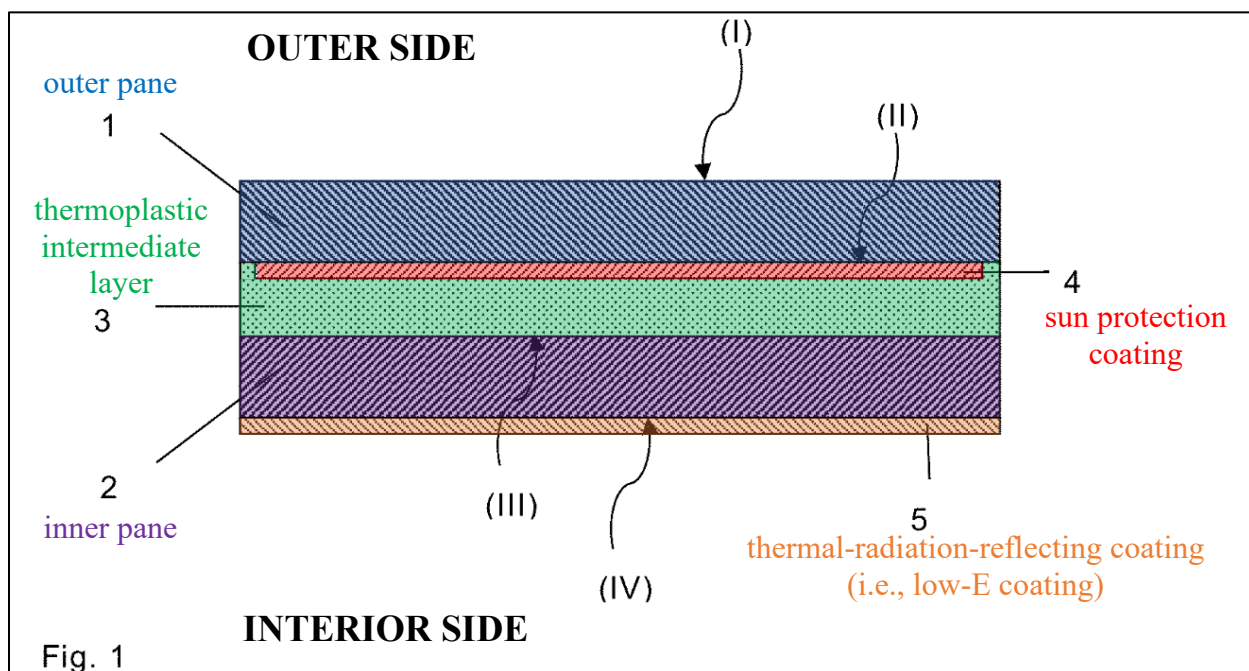
24. In my opinion, a POSITA as of the TOI would have had at least a bachelor's degree in chemistry, chemical engineering, materials science, or similar technical fields as well as two or more years of experience working with solar control windows, glass composite panes, or glass compositions.

25. At the TOI, my level of skill in the art was beyond that of a POSITA. Furthermore, based on my education and my experience working with solar control windows and glass compositions, I worked with individuals who qualified as POSITAs. I am therefore well acquainted with the level of ordinary skill described above. Thus, I am capable of rendering an informed opinion on the level of ordinary

skill in the art at the TOI. My opinions are provided from this perspective of a POSITA at the TOI, whether or not those opinions are explicitly identified as such.

VI. OVERVIEW OF THE '037 PATENT

26. The '037 Patent is directed to a laminated glass pane for use as a vehicle roof panel, as illustrated in annotated Figure 1 below:



Id. at FIG. 1 (annotated); *see also id.* at 1:14–16, 8:29–44. “The composite pane comprises an outer pane 1 and an inner pane 2 that are joined to one another via a thermoplastic intermediate layer 3 ... with the outer pane 1 intended to face the external environment and the inner pane 2 intended to face the vehicle interior.” *Id.* at 8:30–37. The composite pane also has a “sun protection coating 4 ... arranged on the interior-side surface II of the outer pane 1” and a “thermal-radiation-reflecting

coating [i.e., low-E coating] 5 ... arranged on the interior-side surface IV of the inner pane 2.” *Id.* at 8:49–50, 62–63.

27. The ’037 Patent acknowledges that this composite pane structure with a low-E coating on the interior-side surface of the inner pane was already known in the prior art. *Id.* at 1:17–18 (“A composite pane that has the features of the generic part of claim 1 is known, for example, from DE 19927683 C1.”). The specification also identifies WO2013/127563A1, which “discloses another composite pane having a sun protection layer between the glass panes and a low-E coating on the interior-side surface.” *Id.* at 2:6–8.

28. The individual components of the claimed composite pane were likewise known. For example, the specification states that sun protection coatings “are widely used in glazings for buildings, but are also already used in motor vehicles,” and that “[s]uitable sun protection coatings are known, for example, from WO2013/104439A1 as well as from DE 19927683C1.” *Id.* at 4:27–36. Regarding low-E coatings, the patent states that “[s]uch coatings are known, for example, from WO2013/131667A1.” *Id.* at 4:56–57.

29. The ’037 Patent identifies two objectives. The first is “to achieve a constant light reflectance of less than 6%, preferably less than 4%, perceived on the interior side of the inner pane, over the required range of preferred light transmittance through the composite pane of 2 to 10%.” *Id.* at 2:11–15. The second

is “to achieve the lowest TTS value possible.” *Id.* at 2:15–16. TTS refers to total transmitted thermal radiation, which the specification describes as “a measure of the total thermal radiation from the sun transmitted through the pane,” measured according to ISO 9050. *Id.* at 1:36–39. TTS accounts for both directly transmitted solar energy and secondary heat transfer from energy absorbed by the pane and re-radiated inward. The specification explains that these objectives arise because silver-based sun protection coatings “have the intrinsic disadvantage that reflectance in the visible range of light is relatively high at at [*sic*] least 10%,” and this interior-side reflectance “is perceived as a disadvantage by vehicle occupants, in particular those in the rear seats, because visibility through the sunroof or sliding roof is degraded and optical discomfort occurs.” *Id.* at 1:55–2:3.

30. To allegedly achieve these objectives, the '037 Patent fabricates a parameter it calls “transmittance index A,” calculated as:

$$A = \frac{TL_{\text{composite glass pane}}}{(TL_{\text{low-E-coated pane}} \times TE)}$$

where “ $TL_{\text{composite glass pane}}$ ” refers to the light transmittance through the entire composite pane,” “ $TL_{\text{low-E-coated pane}}$ ” refers to the light transmittance through the inner pane together with the thermal-radiation-reflecting coating,” and “TE is the energy transmittance,” each measured according to ISO 9050. *Id.* at 2:31–41. The transmittance index A is not an established parameter known in the art for evaluating

composite panes. The specification states that the “TL values can be suitably adjusted through the selection of the tinting of the components of the composite pane, i.e., the inner pane, the outer pane, and the intermediate layer” and that the “TE value is likewise determined through the selection of the tinting of the components of the composite pane and also through the properties of the sun protection coating and the thermal-radiation-reflecting coating.” ’037 Patent at 2:45–48. “The corresponding values can be suitably selected by the person skilled in the art to achieve a transmittance index A according to the invention.” *Id.* at 2:48–51.

31. The claims of the ’037 Patent state that “the composite pane has a transmittance index A of 0.02 to 0.08,” and that “[s]urprisingly, it has been found that such a composite pane has a low light transmittance of 1 to 12%, preferably of 2 to 10%, and, at the same time, a low total transmitted thermal radiation (TTS) of, in particular, less than 50%, preferably less than 35%, particularly preferably less than 25% . . . with the light reflectance of the composite glass pane being less than 6%, in particular less than 4%.” *Id.* at 2:30–31, 2:55–62. To support this finding, the ’037 Patent presents ten examples, each with transmittance index A within the range 0.02 to 0.08. *Id.* at Table 1. The ’037 Patent also presents one comparative example outside that range, which, notably, had the same if not better light transmittance and reflectivity values as the ten examples within the index range. *Id.* at Table 2. The specification does not identify any performance deficiency with the comparative

example other than its failure to satisfy the claimed index A range, stating only that “the transmittance index A here is clearly outside the targeted range.” ’037 Patent at 10:21–24.

32. In my opinion, the equation to calculate the transmittance index A is fabricated in an arbitrary fashion that is not relevant to the key objectives for the performance of the composite pane for “the lowest possible TTS value in combination with light transmittance of 2 to 10% in order to ensure the best possible compromise between vision outside through the roof and good thermal properties.” *Id.* at 1:45–48. The TTS value correlates to the TE value that can be calculated for Table 1 and the Comparative Example in Table 2 using the equation for transmittance index A. The calculated values for TE in Table 1 range from 0.10 or 10% (Example a, variant with 8% TL of the intermediate layer) to 0.62 or 62% (Example b, variant with 8% TL of the intermediate layer). The calculated value for TE for the Comparative Example in Table 2 is 0.628 or 62.8%, or similar to one example in Table 1 having a TE of 0.62 or 62%.

33. In my opinion, the inclusion of the TL (%) of the low-E pane in the equation for transmittance index A, where the low-E layer, if not tinted, has very little effect on the TL of that pane, is arbitrary and not relevant to the key performance objectives, as, for example, illustrated by the Comparative Example and Example b of Table 1, variant with 8% TL of the intermediate layer. Further, the

range of acceptable TTS or TE values of at least up to 62% is very broad under the equation for A and well above the stated objective for TE.

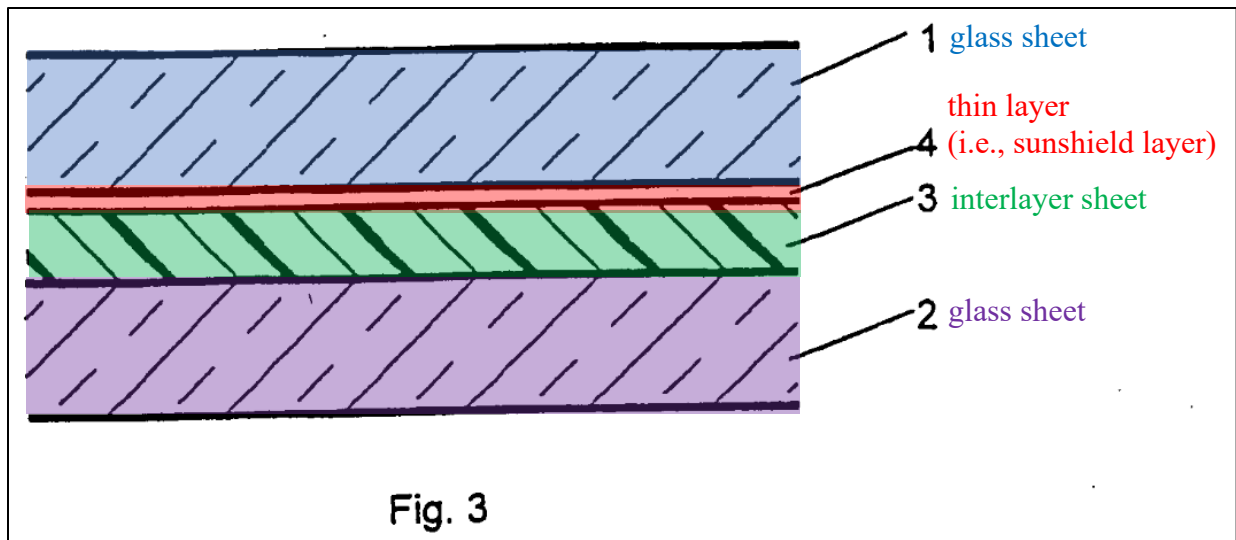
VII. MY TECHNICAL ANALYSIS OF THE PRIOR ART

A. Ground 1A – Claims 1–11, 13, and 15–19 in view of Coster and Manz

1. Overview of Coster

34. Coster is directed to “glazing used for motor vehicles, and in particular to glazing for forming part of roofs or other parts of the motor vehicle which only require a limited light transmission such as side or back glazing units.” Coster at [0001]. Coster explains that design engineers “now undertake to equip vehicles with glazing units which cover a significant part, if not the whole of the roof.” Coster at [0004]. This requirement creates a need for “very efficient solutions in energy control” to protect against “heating of the passenger compartment” while providing satisfactory optical characteristics, including “restricting the luminosity in order to maintain the ‘private’ character of the passenger compartment.” Coster at [0005].

35. Coster discloses laminated glazing units “composed of at least two glass sheets assembled by means of an interlayer sheet made of a thermoplastic material,” such as in Figure 3:



Coster at [0091], FIG. 3 (annotated). FIG. 3 illustrates “two glass sheets 1 and 2” joined by “a thermoplastic interlayer sheet 3” with “a thin layer 4 which is placed on the face of one of the glass sheets on the side of the interlayer.” *Id.* The interlayer materials for layer 3 include “polyvinyl butyral (PVB), polyvinyl acetate (PVA), polyvinyl chloride (PVC), and polyurethane resins (PU).” Coster at [0029]. The interlayer materials “may be chosen, if need be, to contribute to the provision of optical properties of the glazing,” and “[t]he thermoplastic sheets can also play a part in providing the required conditions with respect to light transmission or even with respect to colour.” *Id.*; *see also* Coster at [0030].

36. Coster’s glazing “may also include functional layers,” which “are normally sunshield layers whose main role is to further reduce the energy transmission inside the passenger compartment,” including “metallic layers such as single or multiple layers of silver.” *Id.* at [0062]. These functional layers “are placed

preferably on the faces of the glazing which are not exposed to the ambient air after assembly,” i.e., “the faces in contact with the thermoplastic interlayer sheet.” *Id.* at [0063]. Coster further explains that “each of the sheets is able to receive one or more identical or different layers.” *Id.* at [0067].

37. Coster tests three types of functional sunshield layers: C₁ and C₂, which are “layers of tin oxide doped with antimony,” and C₃, which comprises “layers of silver” of the type described in Finley (EP-B 336257). *Id.* at [0089]. Coster’s C₁ and C₂ layers are low-emissivity layers made of a transparent conductive oxide that reflects infrared light, but they are placed “on the face of the glass turned towards the PVB interlayer” rather than on the interior-side surface of the inner pane of the ’037 Patent’s claims. Coster at [0089], [0090]. C₃ is “a silver-based layer assembly (two layers of silver separated by a layer based on tin oxide)” providing “a transmission even further reduced than previously in the infrared range” with increased “selectivity of this layer (LT/ET).” *Id.* at [0090].

38. Coster provides an extensive table of examples using nine glass types in various combinations of glass composition, glass thickness, and functional layer configuration. *Id.* at [0073]–[0088], [0091]. The glass sheets have thicknesses of “at least 1.8 mm and at most equal to 4 mm.” *Id.* at [0057]. The examples demonstrate light transmittance (LT) values of the composite pane from approximately 4% to

27% and energy transmittance (ET) values from approximately 2% to 20%.¹ Coster at [0091]. With respect to the claims of the '037 Patent, while Coster discloses a thermal-radiation-reflecting coating, i.e., low-E coating, as noted above, it is not on the interior-facing surface of the inner pane (see element 5 in FIG. 1 of the '037 Patent), but this is clearly taught in Manz.

2. Overview of Manz

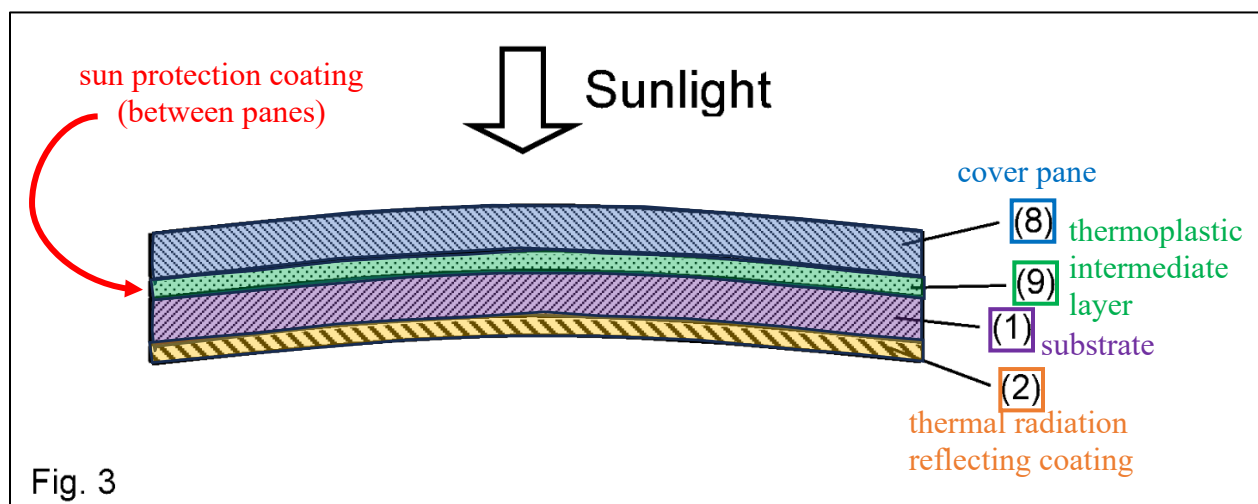
39. Manz is a patent publication for an application that was filed by Saint-Gobain Glass France and lists Florian Manz and Jan Hagen as inventors. Jan Hagen is the first named inventor of the '037 Patent. *Compare* Manz at cover, *with* '037 Patent at cover. However, Manz does not belong in the same patent family as the '037 Patent—it claims priority to a patent application that was filed on February 20, 2013, nearly 5 years before the TOI. Manz at cover.

40. Manz is directed to “a pane with thermal radiation reflecting coating, a method for its production, and its use.” *Id.* at [0001]. Manz explains that “[t]he interior of a motor vehicle can heat up greatly in the summer with high ambient temperatures and intense direct sunlight” and that in winter “a cold pane acts as a heat sink, which is perceived as unpleasant by the occupants,” requiring “[h]igh heating performance of the air-conditioning system.” *Id.* at [0002]; *see also id.* at

¹ Coster’s LT and ET have the same meaning as TL and TE, respectively, as used in the '037 Patent.

[0003]. Manz also notes that “[w]hen the interior-side surface of the pane is provided with a thermal radiation reflecting coating, the reflection cannot be reduced in a simple manner by means of conventional antireflection coatings.” *Id.* at [0005]. Manz’s objective is to provide “an improved pane with thermal radiation reflecting coating” with “reduced interior-side reflection with low light transmittance.” *Id.* at [0006]; *see also id.* at [0026]–[0028], [0030], [0035].

41. Manz discloses the same composite pane as the ’037 Patent, comprising an outer pane (“cover pane 8”) and an inner pane (“substrate 1”) bonded by a “thermoplastic intermediate layer 9,” with a “sun protection coating” between the cover pane 8 and substrate 1 and a corrosion-resistant, TCO-based “thermal radiation reflecting coating 2” on the interior-side surface of substrate 1:



Id. at [0062], [0080], [0090], FIG. 3 (annotated).

42. Like the ’037 Patent, the thermoplastic intermediate layer 9 “preferably contains thermoplastic plastics, for example, polyvinyl butyral (PVB), ethylene

vinyl acetate (EVA), polyurethane (PU), polyethylene terephthalate (PET), or multiple layers thereof.” Manz at [0034]; *see also id.* at [0090]. Also like the ’037 Patent, Manz’s sun protection coating “preferably comprises at least one metallic layer based on silver or a silver-containing alloy” and is “applied on the surface of the substrate facing the cover pane, on the surface of the cover pane facing the substrate, or on a carrier film in the thermoplastic intermediate layer.” *Id.* at [0062].

43. Manz’s thermal radiation reflecting coating comprises an adhesive layer, a functional layer containing “at least one transparent, electrically conductive oxide (TCO),” an optically high-refractive-index layer, and an optically low-refractive-index layer. *Id.* at [0008], claim 1. The functional layer “is largely transparent in the visible spectral range” and contains “particularly preferably indium tin oxide (ITO).” *Id.* at [0036]; *see also id.* at [0087], claim 6. The optically high-refractive-index layer improves “the stability as well as the corrosion and oxidation resistance of the functional layer,” and the optically low-refractive-index layer also improves “the corrosion resistance of the functional layer.” *Id.* at [0041], [0054].

44. The coating “reflects a significant part of sunlight, in particular in the infrared range,” “reduces the emission of long-wave thermal radiation of a heated pane into the vehicle interior,” and does not substantially affect the transmittance in the visible spectral range through the composite pane. *Id.* at [0003], [0091]. The

coating “improves not only the thermal comfort in the interior of the motor vehicle, but also acts as an antireflection coating.” Manz at [0091]. Because Manz’s coating is corrosion and oxidation resistant, it is suitable to be applied on the interior-side facing surface of the inner pane in, for example, a motor vehicle or building. Manz at [0013], [0075], [0090].

3. *Motivation to Combine Coster with Manz*

45. A POSITA would have been motivated to apply Manz’s thermal-radiation-reflecting coating on the interior-side surface of the inner pane of Coster’s laminated glazing, hereinafter referred to as the “Coster-Manz Pane.” Coster and Manz are in the same field—both are directed to laminated glazing for motor vehicles designed to control solar energy and thermal radiation, including roof glazing. Coster at [0001]; Manz at [0001], [0090]. A POSITA working on Coster’s roof glazing would have looked to Manz’s coating as a solution addressing the same thermal comfort problem.

46. The two references address complementary aspects of thermal performance. Coster’s C₃ sun protection coating substantially reduces solar energy transmission but does not address thermal radiation emitted by the heated pane itself into the vehicle interior. Coster at [0062], [0089], [0090]. Manz’s low-E coating addresses this gap by reflecting thermal radiation and reducing the emissivity of the interior-facing surface. Manz at [0026], [0036], [0070]. A POSITA would have

recognized that adding Manz's low-E coating to Coster's glazing would further improve thermal comfort by addressing thermal radiation that Coster's sun protection coating alone does not control.

47. Manz also provides express motivation for the combination. Manz discloses an embodiment combining its thermal-radiation-reflecting coating on the interior-side surface with a silver-based sun protection coating between the panes—precisely the configuration that results from applying Manz's teaching to Coster's C₃ glazing. Manz at [0062]; Coster at [0089], [0090]. Manz states that “[t]hrough the combination of the sun protection coating with the coating according to the invention for reflection of thermal radiation, the thermal comfort in the interior is advantageously further improved.” Manz at [0062].

48. Coster's own disclosures further support the combination. Coster already discloses TCO-based functional layers (C₁ and C₂) alongside the silver-based C₃ layer and contemplates that each glass sheet may receive multiple identical or different layers. Coster at [0067], [0089]. A POSITA would have understood that Coster's glazing is designed to accept multiple functional layers on different surfaces, making the addition of Manz's low-E coating on surface 4 a straightforward modification that has the added benefit of not becoming damaged during the bending process. Manz at [0071].

49. A POSITA would have had a reasonable expectation of success combining Manz's low-E coating to the interior-side surface of the inner pane of Coster's composite pane. Manz's TCO-based coating is corrosion and oxidation resistant and specifically designed to be applied on the interior-facing surface of a pane, unlike prior silver-based low-E coatings. Manz at [0041], [0054]. Furthermore, the coating does not substantially reduce visible-light transmittance, so it would not substantially interfere with Coster's light and energy transmittance targets. Manz at [0091].

4. Claim 1

(a) Limitation 1[p]: A composite pane, comprising

50. The preamble of claim 1 recites that the claimed structure is "a composite pane." The Coster-Manz Pane is a composite pane. Coster discloses a "glazing used for motor vehicles, and in particular to glazing for forming part of roofs or other parts of the motor vehicle." Coster at [0001]. Coster's glazing is a laminated structure comprising "two glass sheets 1 and 2" that "are attached to one another by means of a thermoplastic interlayer sheet 3." Coster at [0091], FIG. 3; *see also* Coster at [0009], [0028], claim 27. A POSITA would have understood Coster's laminated glazing to be a composite pane.

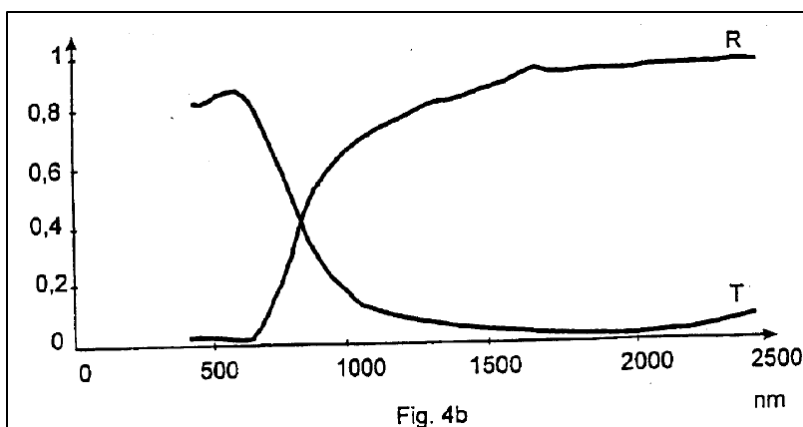
(b) *Limitation 1[a]: an outer pane having an outer-side surface and an interior-side surface, an inner pane having an outer-side surface and an interior-side surface, and a thermoplastic intermediate layer, which joins the interior-side surface of the outer pane to the outer-side surface of the inner pane*

51. Coster's laminated glazing comprises "two glass sheets 1 and 2" joined by "a thermoplastic interlayer sheet 3." Coster at [0091], FIG. 3. Because Coster's glazing is installed in a motor vehicle, the glass pane exposed to the external environment is the outer pane and the glass pane exposed to the internal environment is the inner pane. Coster at [0001], [0005], [0062]. Both glass panes have two surfaces—an outer-side surface that faces the external environment and an interior-side surface that faces the internal environment—which is consistent with the standard four-surface convention described in the '037 Patent. '037 Patent at 8:33–44, FIG. 1. Coster recognizes these surfaces, describing functional layers placed "on the face of the glass turned towards the PVB interlayer" (Coster at [0089]), i.e., on surfaces 2 and 3. A POSITA would have understood that Coster's thermoplastic interlayer sheet joins the interior-side surface of the outer pane (surface 2) to the outer-side surface of the inner pane (surface 3), as required by the claim.

- (c) *Limitation 1[b]: wherein the composite pane has, between the outer pane and the inner pane, at least one sun protection coating, which substantially reflects or absorbs rays outside the visible spectrum of solar radiation*

52. Coster discloses that its glazing “may also include functional layers,” and “[t]hese are normally sunshield layers whose main role is to further reduce the energy transmission inside the passenger compartment.” Coster at [0062]. Among these sunshield layers, Coster describes “metallic layers such as single or multiple layers of silver.” *Id.* Specifically, Coster discloses a silver-based sunshield layer identified as “C₃,” which Coster describes as “layers of silver (C₃) such as those described in the patent publication EP-B 336257.”² Coster at [0089]; *see also* Coster, claims 41–42 (claiming “[g]lazing according to claim 27 comprising at least one silver-based sunshield layer assembly”). FIG. 4b depicts the spectral characteristics of C₃, showing that the reflection curve rises to approximately 0.9–0.95 (90–95% reflectance) for wavelengths above 1500 nm, while the transmission curve drops to near zero beyond approximately 1000 nm:

² The reference to “patent publication EP-B 336257” correlates to E.P. Patent Publication No. 0336257 B1 (Finley).



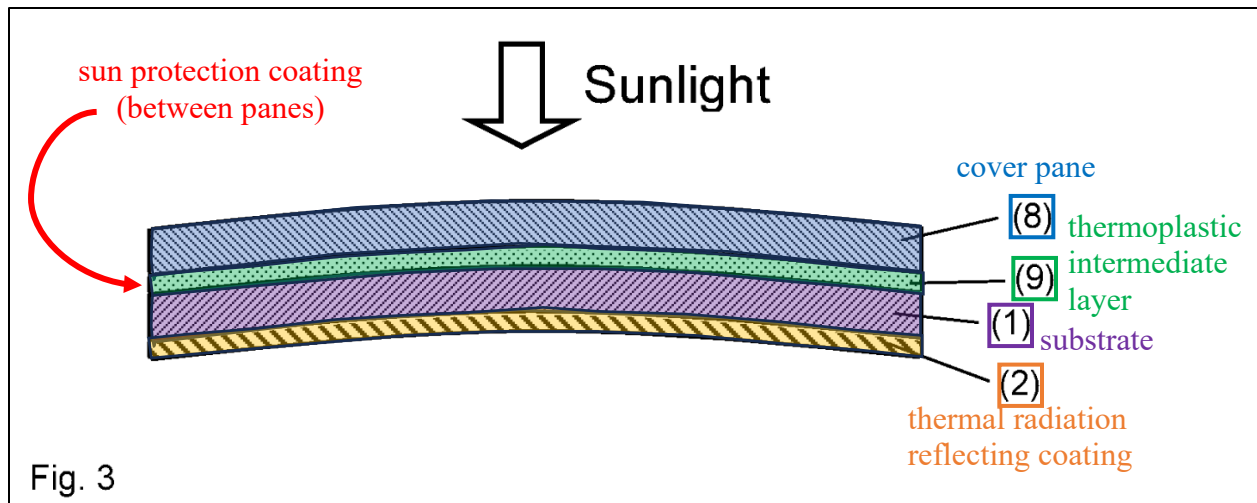
Coster at [0072], [0090], FIG. 4b. A POSITA would have understood that C_3 thus substantially reflects rays outside the visible spectrum of solar radiation. A POSITA would also have understood that the silver-based layer of C_3 had almost ideal optical properties for a glazing for the roof of a vehicle with its very high reflectance in the infrared and its very high transmittance and its very low reflectance in the visible, as shown in FIG. 4b. Very high reflectance in the infrared is greatly preferred in window films, rather than very high absorption, which would result in heat buildup that would transfer excessive thermal radiation to the interior. The use of silver-based layers that reflect 80% or more of the sun's infrared radiation allows tinting of many different combinations of the front glass, the interlayer, and the interior glass to absorb and block the visible light down to the desired light transmission (LT) and energy transmission (TE) values without excessive heat buildup and thermal radiation transfer to the interior.

53. Coster further discloses that the sun protection coating is located between the outer pane and the inner pane. Coster explains that “[w]hen such layers

are present, they are placed preferably on the faces of the glazing which are not exposed to the ambient air after assembly,” i.e., “[t]hese are the faces in contact with the thermoplastic interlayer sheet.” Coster at [0063]. Coster confirms that “[t]he functional layers outside of those inserted with the interlayer are systematically placed on the face of the glass turned towards the PVB interlayer.” Coster at [0089]. A POSITA would have understood that the C₃ sunshield layer is located between the outer pane and the inner pane.

(d) *Limitation 1[c]: wherein the composite pane has, on the interior-side surface of the inner pane, a thermal-radiation-reflecting coating (low-E coating)*

54. Manz discloses a thermal-radiation-reflecting coating that is designed to be corrosion and oxidation resistant and suitable for application on surface 4 of an inner pane or substrate. Manz discloses that “[t]he substrate is bonded to a cover pane via at least one thermoplastic intermediate layer” to form a composite pane, and “the coating is arranged on the surface of the substrate facing away from the cover pane.” *Id.* at [0032]. Manz’s FIG. 3 illustrates this composite pane configuration:



Id. at [0062], [0080], [0090], FIG. 3 (annotated). That is, the coating is on the interior-side surface of the inner pane.

55. Manz’s coating serves the same thermal-radiation-reflecting function described in the ’037 Patent: “[t]he thermal radiation reflecting coating 2 according to the invention surprisingly improves not only the thermal comfort of the interior of the motor vehicle.” Manz at [0091]; *see also* Manz at [0003]. Manz specifies that “[t]he interior-side emissivity of the pane according to the invention is preferably less than or equal to 35%, particularly preferably less than or equal to 25%, most particularly preferably less than or equal to 20%.” Manz at [0026]. A POSITA would understand this thermal radiation reflecting coating of Manz to be the same “thermal-radiation-reflecting coating (low-E coating)” as claimed by the ’037 Patent.

(e) *Limitation 1[d]: wherein the thermal-radiation-reflecting coating contains a transparent conductive oxide*

56. Manz’s thermal radiation reflecting coating includes a functional layer that contains “at least one transparent, electrically conductive oxide (TCO),” “particularly preferably indium tin oxide (ITO).” Manz at [0036]; *see also* Manz at [0008], [0063].

(f) *Limitation 1[e]: the composite pane has light transmittance $TL_{\text{composite glass pane}}$ of 1% to 12%*

57. Fifteen examples from Coster with sunshield layers report light transmittance values of the composite pane squarely within the claimed range of 1% to 12%:

Example No.	$TL_{\text{composite glass pane}} (\%)^3$
29	8.7
43	8.7
86	11.1
101	9.0
102	9.5
103	8.0
104	5.7
117	7.5
118	8.0
119	6.6

³ These values are listed under the “LT” column in Coster. Coster at [0091] Table.

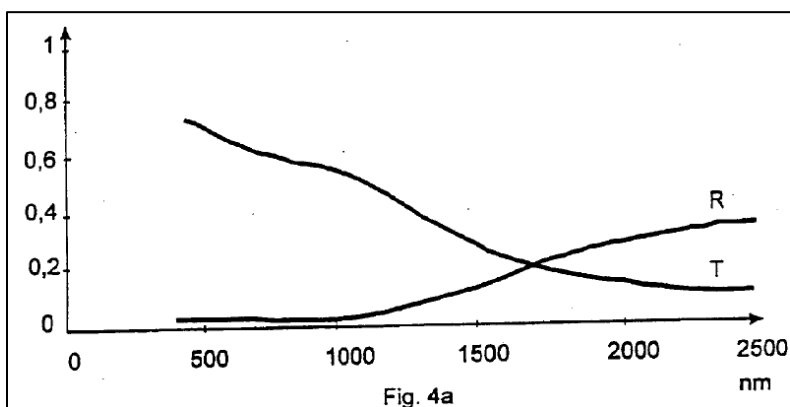
120	4.7
121	11.7
123	10.4
124	7.4
179	9.4

Coster at [0091] Table.

58. Manz’s low-E coating on the interior facing surface of Coster’s inner pane in the Coster-Manz Pane would not materially change the LT values of the composite pane. Manz explains that the functional layer of its coating “is largely transparent in the visible spectral range.” Manz at [0036]. Manz further discloses one embodiment of a composite pane with a low-E coating that has a transmittance (T_L) of 2.2% because it has an interior-side reflection (R_L) of 2.0% and a T_L/R_L ratio of 1.1. Manz at [0091].

59. Coster discloses coatings that are thermal-radiation-reflecting coatings, i.e., low-E coatings. Coster’s C_1 and C_2 layers are “layers of tin oxide doped with antimony.” Coster at [0089]. Antimony-doped tin oxide is a transparent conductive oxide (TCO) that the ’037 Patent identifies as a preferred material for the thermal-radiation-reflecting coating. ’037 Patent at 6:40–46 (listing “antimony-doped tin oxide ($\text{SnO}_2\text{:Sb}$)” as a material for the functional layer of the thermal-radiation-reflecting coating). The ’037 Patent explains that the thermal-radiation-reflecting coating “can also be referred to as a coating with low emissivity, an emissivity-

reducing coating, low-E coating, or low-E layer” and that “[i]ts role is to reflect thermal radiation, i.e., in particular, IR radiation of longer wavelength than the IR component of solar radiation.” ’037 Patent at 6:25–33. FIG. 4a shows that, for Coster’s C_1 layer, “the infrared transmission (from 800 to 2500 nm) is appreciably reduced” and that “[t]he reason for this reduction is the infrared reflection for one part which increases with the wavelength”:



Coster at [0090]; FIG. 4A. However, Coster places its C_1 and C_2 layers “on the face of the glass turned towards the PVB interlayer” (Coster at [0089]) rather than on the interior-side surface of the inner pane (surface 4) as required by this limitation.

60. Coster’s own examples using a similar low-E coating confirm the negligible effect that such coatings have on light transmission. Example 104, which has no low-E coating, has the same light transmission as Example 27, which has the same configuration with the addition of a C_1 low-E coating on the exterior facing surface of the inner pane. Coster at [0091] Table. In other words, the addition of a low-E coating had no effect on the composite pane’s light transmittance. Although

Coster's C₁ coating in Example 27 is on the exterior facing surface of the inner pane, a POSITA would have understood that the effect of the Coster-Manz Pane's low-E coating on the composite pane's light transmittance would be the same regardless of whether it is on the exterior facing or interior facing of the inner pane because light transmittance through the composite pane primarily depends on the total absorption and reflection of each layer in the stack, not on the order in which those layers are encountered.

(g) ***Limitation 1[f]: the composite pane has a transmittance index A of 0.02 to 0.08, wherein the transmittance index A is determined according to the following formula (I) $A = TL_{\text{composite glass pane}} / (TL_{\text{low-E-coated pane}} * TE)$ (I), where TL is the light transmittance and TE is the energy transmittance measured according to ISO 9050***

61. As discussed above in Section VI, transmittance index A is a mathematical relationship between three measurable properties of the composite pane:

$$A = \frac{TL_{\text{composite glass pane}}}{(TL_{\text{low-E-coated pane}} \times TE)}$$

where “TL_{composite glass pane} refers to the light transmittance through the entire composite pane,” “TL_{low-E-coated pane} refers to the light transmittance through the inner pane together with the thermal-radiation-reflecting coating,” and “TE is the energy transmittance,” each measured according to ISO 9050. '037 Patent at 2:31–41, claim 1. Each of the three measurable properties of the formula is an inherent physical

characteristic of the structural composition of the composite pane, and each property has long been utilized in the art for characterizing composite panes. Using these three well-understood parameters, the inventors of the '037 Patent fabricated the mathematical relationship of transmittance index A. In my opinion, composite panes having the claimed structure would readily have a transmittance index A within the claimed range.

62. In any event, Coster discloses “the light transmission of the glazing” (LT) and “the energy transmission of the glazing” (ET) for each example glazing, which correspond to the $TL_{\text{composite glass pane}}$ and TE variables, respectively, recited in the claimed equation. Coster at [0084], [0085], [0091] Table.

63. A POSITA would also understand how to calculate the remaining $TL_{\text{low-E-coated pane}}$ parameter from the known optical properties of Coster’s inner pane glass. *See* Coster at [0074], [0075] Table; Manz at [0091]. Coster reports the light transmittance of each glass type used in its examples at a reference thickness (LTA4). Coster at [0075] Table. Coster defines LTA4 as “the total light transmission for illuminant A (LTA) measured for a thickness of 4 mm (LTA4).” Coster at [0018]; *see also* Coster at [0074] (confirming that “[t]he measurements of the optical properties, except for P, are given for the reference thickness of 4 mm”). Coster’s LTA4 values provide the starting point for determining $TL_{\text{low-E-coated pane}}$ because a POSITA would have understood that the light transmittance of the inner pane glass

is the primary determinant of $TL_{\text{low-E-coated pane}}$. However, the inner pane (V_2) for each of the examples cited above has a thickness of 2.1 mm, not 4 mm. Coster at [0091] Table (Examples 29, 43, 86, 101–104, 117–121, 123, 124, and 179). A POSITA would have known to convert the LTA4 values to the light transmittance at 2.1 mm using the Beer-Lambert relationship, which governs the attenuation of light through an absorbing medium.

64. The Beer-Lambert conversion would also account for the expected surface reflectance of a standard air-glass interface, which is approximately 4.2% per surface, yielding a surface transmittance factor of $T_{\text{surface}} = (1 - 0.042)^2 \approx 0.918$. The internal transmittance at 4 mm is first isolated by dividing the measured LTA4 by T_{surface} . The absorption coefficient is then determined, and the internal transmittance at 2.1 mm is calculated using the Beer-Lambert relationship. The light transmittance at 2.1 mm is obtained by multiplying the internal transmittance at 2.1 mm by T_{surface} . The calculated values for light transmission at 2.1 mm are shown in the following table:

Glass Type	LT (%, at 4 mm) ⁴	LT (%, at 2.1 mm) ⁵
I	16.9	37.8
II	45.3	63.4

⁴ These values are listed in “LTA4” row in Coster. Coster at [0075] Table.

⁵ These values are the result of converting the LTA4 values using the Beer-Lambert relationship.

III	32.2	53.0
IV	40.7	59.9
V	35.9	56.1
VI	27.3	48.6
VII	10.0	28.7

Coster at [0074], [0075] Table.

65. A POSITA would understand that the addition of Manz’s low-E coating on the interior-side surface of the inner pane (surface 4) has little to no effect on the inner pane’s light transmittance. Manz explains that the functional layer of its coating “is largely transparent in the visible spectral range.” Manz at [0036]. Furthermore, as discussed in Section VII.A.4(f), Manz further discloses one embodiment of a composite pane with a low-E coating that has a light transmittance of 2.2%, which is only a 0.1% decrease from the 2.3% light transmittance for a composite pane without the low-E coating. Manz at [0091].

66. With respect to energy transmittance, Manz’s low-E coating is designed to reflect thermal radiation—i.e., longer-wavelength infrared radiation—rather than the solar radiation in the near-infrared range that contributes to TE as measured by ISO 9050. *See* ’037 Patent at 4:60–62 (“[The low-E coating’s] role is to reflect thermal radiation, i.e., in particular IR radiation of longer wavelength than the IR component of solar radiation.”). Coster’s data confirms that the addition of a low-E coating also has a minimal effect on both the light and energy transmittance of the

composite pane. Comparing Coster's Example 104, which has no low-E coating, with Example 27, which has the same configuration with the addition of a C₁ low-E coating on surface 3, the LT remained the same at 5.7%, and the ET decreased from 4.8% to 3.4%—a 29.2% reduction. Coster at [0091] Table. Although Coster's C₁ coating in Example 27 is on surface 3 rather than surface 4, a POSITA would have understood that the effect of a low-E coating on ET would be largely the same regardless of whether it is on surface 3 or surface 4. A POSITA would reasonably expect a similar 29.2% reduction in the ET value when using a low-E coating on surface 4.

67. Using the values disclosed in Coster and adjusted, as discussed above, to calculate the transmittance index A according to the formula in claim 1, a POSITA would understand that at least fifteen of Coster's example composite panes using Manz's low-E coating on the inside surface of the inner pane would have a transmittance index A within the claimed range of 0.02 to 0.08:

Example No.	TL_{composite glass pane} (%)	TL_{low-E-coated pane}⁶ (%)	TE⁷ (%)	Index A⁸
29	8.7	37.8	3.8	0.061
43	8.7	37.8	3.8	0.061

⁶ As calculated by a POSITA applying the calculated values for light transmission at 2.1 mm thickness.

⁷ As calculated by a POSITA applying a 29.2% reduction to Coster ET value.

⁸ Calculated by using listed values in this table in the claimed formula for transmittance index A.

86	11.1	48.6	3.9	0.059
101	9.0	59.9	4.1	0.037
102	9.5	63.4	4.2	0.036
103	8.0	53.0	3.5	0.043
104	5.7	37.8	3.4	0.044
117	7.5	59.9	3.7	0.034
118	8.0	56.1	3.9	0.037
119	6.6	53.0	3.2	0.039
120	4.7	37.8	3.1	0.040
121	11.7	59.9	5.8	0.034
123	10.4	53.0	5.0	0.039
124	7.4	37.8	4.7	0.042
179	9.4	59.9	3.8	0.041

Coster at [0091] Table. Additionally, I note that the results of index A calculation for the fifteen Coster examples above would still remain within the claimed range of 0.02 to 0.08 even if the ET values for each Coster example did not have the 29.2% reduction applied.⁹ A POSITA would not expect a significant reduction (e.g., more than approximately 71% for all fifteen examples to reach an index A above 0.08) in TE values simply by adding a low-E coating to surface 4.

⁹ The calculated values of index A for the fifteen Coster examples would range between 0.024 and 0.043. I further observe that if index A were calculated using the data for Example 27 with no TE correction, the result would be an index A of 0.044.

5. ***Claim 2: The composite pane according to claim 1, wherein light reflectance at the interior-side surface of the inner pane at an angle of 8° is less than 6%***

68. Manz discloses that adding its low-E coating to a composite pane results in a reflectivity of less than 6% at incidence angles between 0° and 45°. For example, Manz discloses that “[t]he interior-side reflection R_L is reduced to 2.0% by the coating 2.” Manz at [0091]. Manz also discloses that the T_L/R_L ratio without the coating is 0.5 and with the coating is 1.1. *Id.* According to simulated measurements of Figures 4, 5, 6, and 7, the T_L/R_L ratio of 0.5 for the pane without the coating correlates to a 45° incident angle. *Id.* at [0092], FIGS. 4–7. A POSITA would expect the measurements for the composite pane with the coating to be made at the same incident angle. Additionally, the simulated T_L/R_L ratio measurements using a 45° incident angle for a composite pane with a coating that has the adhesive layer 3 (30 nm thickness), the functional layer 4 (130 nm thickness), the high-refractive-index layer 5 (5 nm thickness), and the low-refractive-index layer 6 (70 nm thickness) are relatively close to the measured 1.1 ratio. *Id.* at [0087], [0091]. A POSITA would also understand that the reflectivity necessarily decreases at smaller incidence angles, and the reflectivity at 8° would be less than the 2.0% measured at the 45° incident angle. *See* Manz at FIGS. 4–7.

6. ***Claim 3: The composite pane according to claim 1, wherein the sun protection coating comprises a layer system with at least one metal layer embedded between dielectric oxide or nitride layers***

69. As discussed in Section VII.A.4(c) (Limitation 1[b]), Coster discloses that its C₃ layer is a silver-based sunshield coating of the type described in Finley (EP0336257). Coster at [0089]. Finley discloses that the coatings “generally comprise a thin metallic layer, for infrared reflectance and low emissivity, sandwiched between dielectric layers of metal oxides.” Finley at 2:8–12; *see also* Finley at 5:14–19 (“Such films typically comprise multiple layers, preferably a layer of a highly reflective metal such as gold or silver sandwiched between antireflective metal oxide layers selected from indium oxide and oxides of an alloy of zinc and tin which preferably comprises zinc stannate”). A POSITA would have understood that Coster’s C₃ comprises silver metal layers embedded between dielectric oxide layers, such as zinc stannate (Zn₂SnO₄).

7. ***Claim 4: The composite pane according to claim 1, wherein the sun protection coating is applied directly to the interior-side surface of the outer pane***

70. Coster discloses that its functional sunshield layers “are systematically placed on the face of the glass turned towards the PVB interlayer.” Coster at [0089]; *see also* Coster at [0063]. A POSITA would understand that the C₃ sunshield layer is applied directly to the interior-side facing surface of the outer pane, as confirmed

by Coster's examples. Coster at [0091] Table (Examples 29, 43, 86, 101–104, 117–121, 123, and 124).

8. *Claim 5: The composite pane according to claim 1, wherein the sun protection coating is arranged on a carrier film embedded in the intermediate layer*

71. Coster discloses that, in some examples, such as Example 179, “the interlayer is formed from an assembly composed of PVB combined with a PET sheet on which a stack based on silver layers is deposited.”¹⁰ Coster at [0077]; *see also* Coster, claim 42. A POSITA would understand that the stack of silver layers would act as a sun protection coating and the PET sheet is a carrier film embedded in the PVB interlayer on which the sun protection coating is deposited. *See* '037 Patent at 4:20–34 (describing multiple silver functional layers as an understood and common implementation of a sun protection coating).

9. *Claim 6: The composite pane according to claim 1, wherein the intermediate layer is formed from at least one polymer film*

72. Coster discloses that “[t]he materials forming the basis for the interlayer sheet are, in particular, polyvinyl butyral (PVB), polyvinyl acetate (PVA), polyvinyl chloride (PVC), and polyurethane resins (PU).” Coster at [0029]; *see also* Coster at [0077]. A POSITA would have understood that PVB, PVA, PVC, and PU are each

¹⁰ Coster indicates that “[i]n the table the presence of this particular interlayer is recorded in the column relating to the layers by marking with S.” Coster at [0077].

polymer films. *See* '037 Patent at 3:39–44 (describing PVB and PU as “thermoplastic films”).

10. *Claim 7: The composite pane according to claim 6, wherein the at least one polymer film has light transmittance of 2% to 80%*

73. Coster discloses that its glazing has “a light transmission, LT, which is not more than 35%.” Coster at [0009]. Coster further explains that “this impression may be retained with very low light transmissions, e.g. in the order of 5% or less.” Coster at [0013]. Additionally, Coster’s interlayer materials “may be chosen, if need be, to contribute to the provision of optical properties of the glazing” and that “[t]he thermoplastic sheets can also play a part in providing the required conditions with respect to light transmission or even with respect to colour.” Coster at [0029]; *see also* Coster at [0030], claim 43. Coster also identifies specific examples using a blue-colored interlayer sheet. Coster at [0077].

74. Manz also discloses achieving lower light transmittances of a composite pane by several approaches, including tinting or coloring the substrate, the cover layer, and/or the thermoplastic intermediate layer. Manz at [0035]. A POSITA would naturally look to tinting interlayer materials to achieve the low light transmissions taught by Coster. Moreover, tinted thermoplastic intermediate layers with light transmittances below 80% were commercially available prior to the TOI. Barton-001 describes using “body-tinted PVB” from Sekisui Chemical Co. Ltd. and E.I. du Pont de Nemours that has a visible light transmission of 18%. Barton-001 at

[0068]. Similarly, Barton-246 discloses using tinted PVB with 35% and 18% light transmittance from Solutia Inc. Barton-246 at 10:40–44. A POSITA would utilize a tinted thermoplastic intermediate layer to achieve Coster’s low light transmission for the composite pane, which would involve routine experimentation with commercially available tinted PVB with predictable results.

- 11. Claim 8: The composite pane according to claim 1, wherein the thermal-radiation-reflecting coating contains indium tin oxide, antimony-doped or fluorine-doped tin oxide and/or aluminum-doped zinc oxide (ZnO:Al) and/or gallium-doped zinc oxide (ZnO:Ga)**

75. Manz discloses “[t]he functional layer preferably contains at least fluorine-doped tin oxide (SnO₂:F), antimony-doped tin oxide (SnO₂:Sb), and/or indium tin oxide (ITO).” Manz at [0036]. A POSITA would understand that Manz discloses a low-E coating that contains indium tin oxide, antimony-doped or fluorine-doped tin oxide, aluminum-doped zinc oxide, and/or gallium-doped zinc oxide.

- 12. Claim 9: The composite pane according to claim 1, wherein the inner pane together with the thermal-radiation-reflecting coating applied thereto has light transmittance $TL_{\text{low-E-coated pane}}$ of 25% to 95%**

76. As discussed in Section VII.A.4(g) (Limitation 1[f]), the light transmittance of Coster’s inner pane glass at 2.1 mm ranges from 28.7% (Glass VII) to 63.4% (Glass II). Coster at [0074], [0075]. Every one of these values also falls within the narrower claimed range of 25% to 95%. Moreover, the addition of Manz’s low-E coating has little to no effect on light transmittance. Manz at [0091]. Thus, a

POSITA would understand that the $TL_{\text{low-E-coated pane}}$ values would remain substantially unchanged and well within 25% to 95%, as required by the claim.

13. Claim 10: The composite pane according to claim 1, which has light transmittance $TL_{\text{composite glass pane}}$ of 2% to 10%

77. As shown in Section VII.A.4(f) (Limitation 1[e]), twelve of Coster's C_3 examples report $TL_{\text{composite glass pane}}$ values within the narrower range of 2% to 10%: Examples 29, 43, 101–104, 117–120, 124, and 179, with $TL_{\text{composite glass pane}}$ values ranging from 4.7% to 9.5%. Coster at [0091] Table. Moreover, as discussed above, the addition of Manz's low-E coating has little to no effect on the composite pane's light transmittance. Manz at [0091].

14. Claim 11: The composite pane according to claim 1, wherein the inner pane with the thermal-radiation-reflecting coating applied thereto has light reflectance at an angle of 8° of less than 6%

78. As shown in Section VII.A.5 (Ground 1A, Claim 2), Manz discloses that adding its low-E coating to a composite pane results in a reflectivity of less than 6% at incidence angles between 0° and 45° . Manz at [0091], FIGS. 4–7.

15. Claim 13: The composite pane according to claim 1, wherein the outer pane and/or the inner pane have a thickness of 0.5 mm to 4 mm

79. Coster states that “the glass sheets used to form the laminated glazing advantageously have a thickness of at least 1.8 mm and at most equal to 4 mm.” Coster at [0057]. In each of Examples 29, 43, 86, 101–104, 117–121, 123, 124, and 179 of Coster, the outer pane has a thickness between 2.1 mm and 3.9 mm, and the inner pane has a thickness of 2.1 mm. Coster at [0091] Table.

16. Claim 15: A method comprising utilizing composite pane according to claim 1 as a roof panel of a vehicle

80. Coster is expressly directed to “glazing used for motor vehicles, and in particular to glazing for forming part of roofs.” Coster at [0001]; *see also* Coster at [0008], [0027], claim 45. Manz likewise discloses that its composite pane with low visible-light transmittance “is intended as a roof panel for a motor vehicle.” Manz at [0090]; *see also id.* at [0075].

17. Claim 16: The composite pane according to claim 1, wherein the at least one sun protection coating substantially reflects or absorbs infrared rays

81. As discussed in Section VII.A.4(c) (Limitation 1[b]), Coster’s C₃ layer is a silver-based sunshield layer that provides “a transmission even further reduced than previously in the infrared range” with increased “selectivity of this layer (LT/ET).” Coster at [0090]. Coster discloses approximately 90–95% reflectance by C₃ of infrared light above 1500 nm. Coster at [0072], [0090], FIG. 4b. These spectral characteristics are consistent with the listed ET values of 4.4% to 12.4% reported for Coster’s C₃ examples. Coster at [0091] Table. For example, Example 172 of Coster has the same outer and inner pane glass types and thicknesses as Example 101 but does not include the C₃ sunlayer, and, as a result, Example 172 has a listed ET value of 12.7%, which is over twice as high as the listed ET value for Example 101 of 5.8%. *Id.*

18. Claim 17: The composite pane according to claim 3, wherein the at least one metal layer embedded between dielectric oxide or nitride layers is at least one metallic silver layer

82. As discussed above in Section VII.A.6 (Ground 1A, Claim 3), Coster's C₃ layer is "a silver-based layer assembly (two layers of silver separated by a layer based on tin oxide)." Coster at [0090]; *see also* Coster at [0089], claim 41.

19. Claim 18: The composite pane according to claim 6, wherein the at least one polymer film contains polyvinyl butyral, ethylene vinyl acetate, polyurethane, and/or mixtures thereof and/or copolymers thereof

83. As discussed above in Section VII.A.9 (Ground 1A, Claim 6), Coster expressly discloses that its polymer films of the intermediate layer consist of materials including "polyvinyl butyral (PVB)" and "polyurethane resins (PU)." Coster at [0029], [0077].

20. Claim 19: The composite pane according to claim 7, wherein the at least one polymer film has light transmittance of 8% to 36%

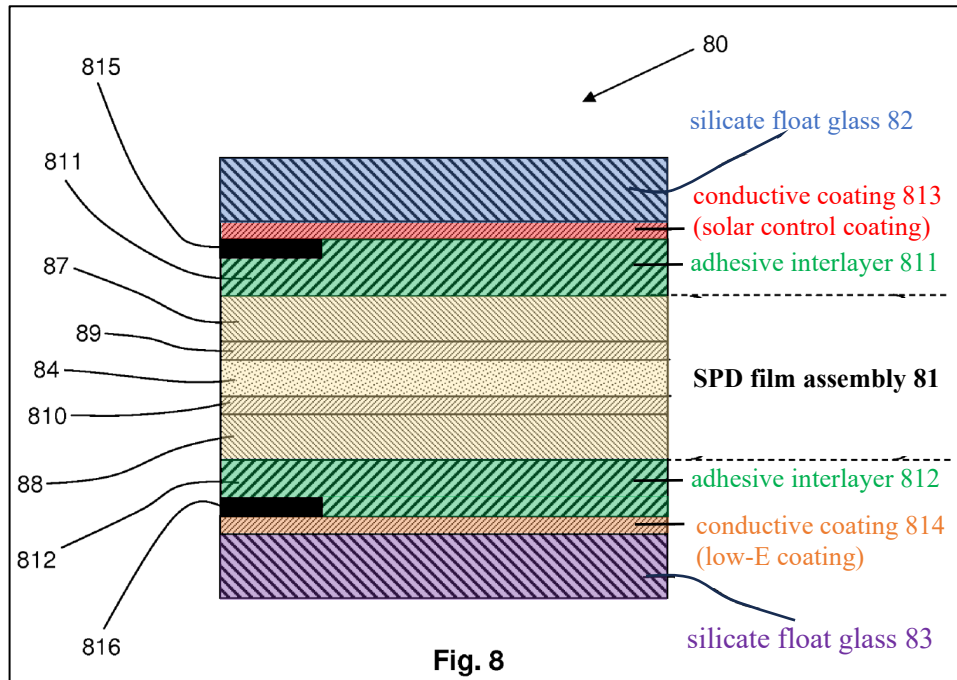
84. As discussed above in Section VII.A.10 (Ground 1A, Claim 7), Coster teaches that the tint of the intermediate layer can be selected to adjust light transmission. Coster at [0029], [0030], claim 43. Tinted thermoplastic intermediate layers with light transmittances above 8% and below 36% were commercially available prior to the TOI. *See* Barton-001 at [0068]; Barton-246 at 10:40–44.

B. Ground 1B –Claims 14 and 20 in view of Coster, Manz, and Boote

1. Overview of Boote

85. Boote is directed to switchable films—including “SPDs (suspended particle devices)” and “LCDs (liquid crystal devices)” —embedded within laminated glazing structures. Boote at 1:11–17. Boote describes the SPD film assembly as comprising “an active layer of a suspended particle emulsion” arranged between two planar electrodes, where the optical transmission of the active layer changes with an applied voltage. Boote at 1:30–35. The SPD film assembly is “switchable between a dark state (when no voltage is applied), and a highly transparent state (when voltage is applied).” Boote at 1:22–24.

86. Boote also discloses embedding the switchable film assembly within a laminated glazing using a “picture frame” design in which the film is placed between interlayers and laminated between two plies of glass, as shown in FIG. 8:



Boote at 2:1–8, FIG. 8. FIG. 8 illustrates a laminated glazing with an SPD film assembly 81 laminated between two plies of silicate float glass 82, 83 by two plies of PVB adhesive interlayer material 811, 812. Boote at 9:54–10:4. In this embodiment, each glass ply is provided with electrically conductive coatings 813, 814, which “include low emissivity coatings and solar control coatings.” Boote at 10:4–12. Boote’s low emissivity coatings include “fluorine-doped tin oxide or tin-doped indium oxide,” and its “solar control coatings comprise layers of silver or tin oxide.” Boote at 10:16–28. Remote electrical connector regions 815, 816, formed from tinned copper strips, are attached to the surface of the electrically conductive coatings and to a power supply. Boote at 10:34–51. “When the power supply was turned on, the optical transmission of the SPD film increased.” Boote at 10:51–53.

87. Although Boote's embodiments use SPD films, "the invention is equally applicable to other switchable films," including "LCD films." Boote at 6:27–34. Boote also discloses that its glazing comprising a switchable film assembly may be used as a vehicle window. Boote at 11:1–5.

2. *Motivation to Combine Boote with Coster & Manz*

88. A POSITA would have been motivated to embed Boote's switchable film assembly in the thermoplastic intermediate layer of the Coster-Manz Pane, hereinafter referred to as the "Coster-Manz-Boote Pane."

89. Boote, Coster, and Manz are all directed to laminated glazing structures for motor vehicles, including roof glazings. Coster at [0001]; Manz at [0013]; Boote at 11:1–5. A POSITA would have recognized that embedding Boote's SPD element in Coster's intermediate layer would allow the occupant to electrically control light transmittance, supplementing the fixed sun protection of Coster's C₃ coating and the thermal radiation control of Manz's low-E coating.

90. Boote already discloses a laminated glazing combining a switchable SPD film assembly with low emissivity and solar control coatings on the glass panes—a configuration directly analogous to adding Boote's switchable element to the Coster-Manz combination. Boote at 10:4–12, FIG. 8. A POSITA would have had a reasonable expectation of success because Boote demonstrates successful

lamination of SPD film assemblies between glass plies using PVB—the same interlayer material used in Coster’s glazing. Boote at 9:54–10:4; Coster at [0029].

3. *Claim 14: The composite pane according to claim 1, wherein a functional element with electrically controllable optical properties is embedded in the intermediate layer*

91. Boote discloses a switchable SPD film assembly in which an active layer has an optical transmission that changes upon application of an electric field. Boote at 1:11–35; 3:7–17. A POSITA would have understood that Boote’s SPD film assembly is a functional element with electrically controllable optical properties because the optical transmission of its active layer changes with an applied voltage. Boote further discloses embedding the SPD film assembly between two plies of glass, being adhered to the plies using plies of PVB adhesive interlayer material. Boote at 9:54–10:4, FIG. 8; claim 9. A POSITA would have understood that Boote’s SPD film assembly, laminated between PVB interlayer plies positioned between two glass plies, is embedded in the intermediate layer.

4. *Claim 20: The composite pane according to claim 14, wherein the functional element with electrically controllable optical properties is a PDLC element or an SPD element*

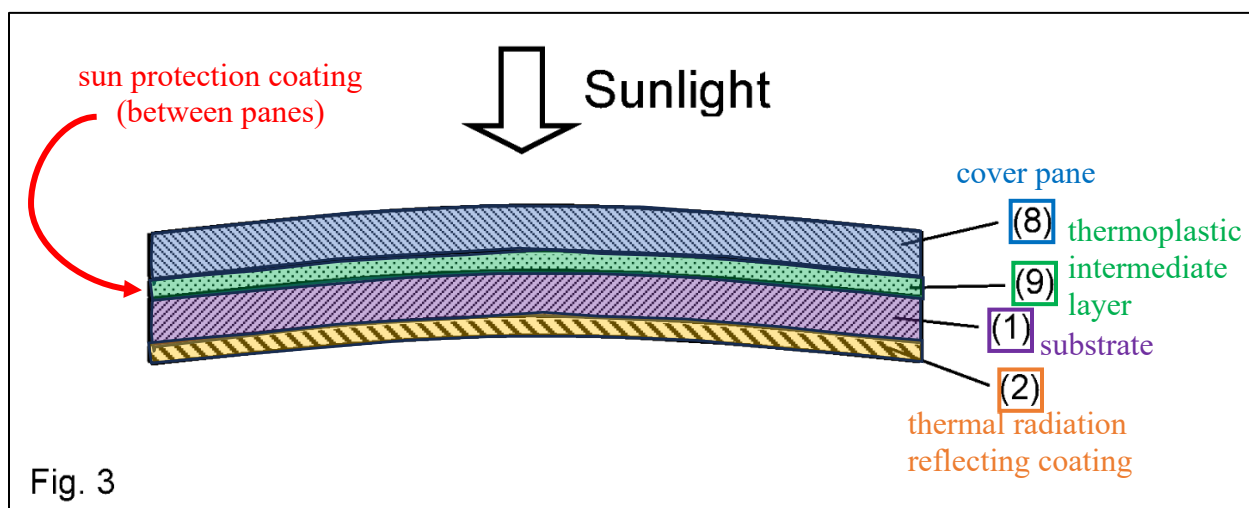
92. As discussed in Section VII.B.3 (Ground 1B, Claim 14), Boote discloses an SPD film assembly, which is comprised of “an active layer of a suspended particle emulsion.” Boote at 1:30–35; 9:54–61. A POSITA would have

understood that an SPD film assembly is an SPD functional element as recited in Claim 20.

C. Ground 2A –Claims 1–13 and 15–19 in view of Manz and Fardel

1. Overview of Manz

93. As discussed in Section VII.A.2, Manz discloses a composite pane that comprises an outer pane (“cover pane 8”) and an inner pane (“substrate 1”) bonded by a “thermoplastic intermediate layer 9,” with a “sun protection coating” between the cover pane 8 and substrate 1 and a corrosion-resistant, TCO-based “thermal radiation reflecting coating 2” on the interior-side surface of substrate 1:



Id. at [0062], [0080], [0090], FIG. 3 (annotated).

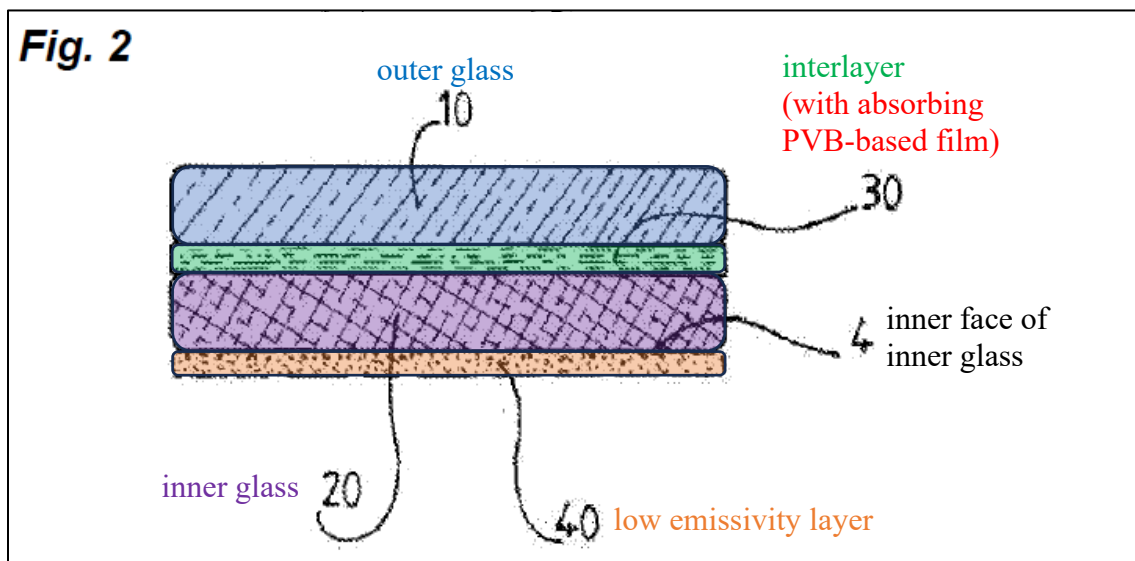
94. Thus, Manz’s composite pane includes all of the structural elements of the composite pane recited in claim 1 of the ’037 Patent. Like the ’037 Patent, Manz explains that “[t]hrough the combination of the sun protection coating with the coating according to the invention for reflection of thermal radiation, the thermal

comfort in the interior is advantageously further improved.” *Id.* at [0062]. Also like the ’037 Patent, Manz discloses that its composite pane “preferably has transmittance in the visible spectral range of less than 4%” and that “[w]ith panes with such low transmittance, the interior-side reflection level is particularly advantageously reduced.” *Id.* at [0027]; *see also* ’037 Patent at 2:11–15 (targeting “light reflectance of less than 6%, preferably less than 4%”). Indeed, Manz’s stated objective is to provide an improved pane with “reduced interior-side reflection with low light transmittance” and low total energy input from sunlight (TTS)—the same objectives identified by the ’037 Patent. *Id.* at [0006], [0030]; ’037 Patent at 2:11–16. Manz also discloses how the transmittance can be reduced through the use of a tinted and/or colored substrate, cover pane, and/or thermoplastic intermediate layer. *Id.* at [0035]. And like the ’037 Patent, this composite pane “is intended as a roof panel for a motor vehicle.” *Id.* at [0090].

2. Overview of Fardel

95. Fardel is directed to “high thermal performance glazing for a vehicle, in particular for a motor vehicle roof.” Fardel at [0001]. Fardel explains that existing vehicle roof glazings are “made of glazing consisting of tinted glass laminated together by a clear or tinted PVB interlayer.” Fardel at [0002]. These glazings are “now systematically complemented by an interior blackout blind” “which allows the opening given to the outside by the glazing to be visually and thermally closed,” but

this blind “results in an additional mass” and “an additional volume, necessary for its installation under the glazing.” Fardel at [0003]. Fardel observes that relying solely on tinted glass to achieve thermal performance is inadequate because “[h]igh thermal performance with such a design is accompanied by reduced light transmission and increased energy absorption in the glazing,” which “causes it to heat up, and the glazing re-emits this energy by infrared radiation both inwards and outwards from the vehicle.” Fardel at [0007]. Fardel’s objective is to provide a roof glazing with “performance such that it makes it possible to do without the blackout blind to guarantee a good level of thermal comfort in the passenger compartment of the vehicle.” Fardel at [0008]. To achieve this, Fardel discloses a laminated glazing such as in annotated FIG. 2 below:



The laminated glazing is “composed of an outer glass 10, an inner glass 20, an interlayer 30 between the two glass 10 and 20 consisting of at least one PVB-based

absorbing and acoustic film, and a layer called ‘low emissivity layer’, referenced 40, on the inner face 4 of the inner glass 20.” Fardel at [0035], FIG. 2 (annotated).

96. Fardel explains that “[t]he choice of a ‘tinted’ glass involves selecting, from among the many available glass references, the glass with the lowest energy performance (expressed by the ET coefficient) while maintaining sufficiently high optical performance (expressed by the LT coefficient) in order to achieve the desired results on the final assembled glazing.” Fardel at [0033]. Fardel discloses multiple configurations for achieving these results: tinted outer and inner glasses (Fardel at [0012]), clear glasses with a tinted low-emissivity layer (Fardel at [0013]), or “the use of a tinted outer glass, and of a clear inner glass as a support for the low-emissivity layer” (Fardel at [0014]). With this last configuration, Fardel explains that the clear inner glass, “once coated with the low emissivity layer, will behave like tinted glass during the forming of the glazing.” Fardel at [0038]. Fardel further teaches that the intermediate layer can be provided with a specific tint to adjust the transmission color and light transmission of the glazing. Fardel at [0040]. Fardel explains that a target of “a light transmission LT of the complete glazing of less than 8% should be chosen, so as to avoid introducing lighting conditions that could cause glare.” Fardel at [0046].

97. Fardel’s Table I reports the optical performance of a specific embodiment of the glazing:

Table I

Component	Nature
Exterior glass 10	2.1mm thick gray tinted glass LT = 29% and ET = 25%
PVB acoustic absorbent 30	PVB Sekisui © SSF thickness 0.76mm
Interior glass 20	Clear glass thickness 2.1 mm LT = 29% and ET = 25%

(continued)

Component	Nature
Low-emissivity layer 40	Emissivity 0.20
Assembled glazing	LT = 6.7%; ET = 4.2%; g = 19.2%; TTF = 3.77%; 124 W/m²
Tinted “sky” reference	LT = 24.0%; ET = 14.9%; g = 35.7%; TTF = 15.5%; 254 W/m ²

where:

LT: luminous transmission under illuminant D65 (see ISO 9050),

ET: energy transmission, with “Moon Air Mass” = 2, according to ISO 9050 standard (“Moon Air Mass” being the air mass as defined by P. Moon),

g: solar factor according to ISO 9050 standard (Air mass 1.5),

TTF: as defined by Hisashi Ogawa, Tatsuya Noguchi, Takashi Muromachi, Harunori Murakami, NIPPON SHEET GLASS Co., Ltd, and Transmitted power (in W/m²): under external radiation according to illuminant D65 of 1000 W/m².

Fardel at [0043], Table I. These values are measured according to ISO 9050. Fardel at [0043], [0045].

3. Motivation to Combine Manz with Fardel

98. A POSITA would have been motivated to configure Manz’s composite pane with optical properties consistent with Fardel’s teachings, hereinafter referred to as the “Manz-Fardel Pane,” and would have had a reasonable expectation of success in doing so.

99. Manz and Fardel are in the same field—both are directed to glazings for motor vehicles designed to improve thermal comfort, including roof glazings. Manz at [0001], [0090], [0091]; Fardel at [0001]. Both references address the same fundamental problem: reducing heat transmission into the vehicle interior through

the roof glazing. Manz at [0002]; Fardel at [0007]. A POSITA working to configure Manz's composite pane for use as a roof panel would have looked to Fardel as a reference in the same field addressing the same problem.

100. Manz and Fardel also disclose the same basic composite pane structure. Both disclose a laminated glazing comprising an outer glass, an inner glass, a PVB intermediate layer, and a low-emissivity layer on the inner face of the inner glass. Manz at [0062], [0090]; Fardel at [0011], [0035]. Both disclose a sun protection mechanism between the inner and outer panes—Manz through a silver-based sun protection coating (Manz at [0062]) and Fardel through an absorbent PVB interlayer (Fardel at [0037]). Both disclose a low-emissivity layer with an emissivity less than or equal to 20%. Manz at [0026]; Fardel at [0039].

101. Fardel's disclosures further support the combination by providing specific performance targets for the type of roof glazing Manz contemplates. Manz discloses that its composite pane can achieve low visible-light transmittance for use as a roof panel (Manz at [0091]), but does not specify the particular combination of component properties needed to achieve a desired TE. Fardel fills this gap, reporting a specific, working configuration that eliminates the need for an occluding mask while maintaining thermal comfort in the vehicle cabin. Fardel at [0008], [0043], [0046], Table I. A POSITA would have been motivated to select component properties consistent with Fardel's Table I.

102. Both references recognize that the variables determining performance are adjustable design parameters. Manz teaches that visible-light transmittance can be adjusted through the selection of tinted or colored panes and intermediate layers. Manz at [0035]. Fardel likewise teaches that these variables are design choices selected to achieve desired optical performance. Fardel at [0033], [0046]. The '037 Patent confirms that “the corresponding values can be suitably selected by the person skilled in the art to achieve a transmittance index A according to the invention.” '037 Patent at 4:16–22.

103. Additionally, a POSITA would have had a reasonable expectation of success using Fardel's values. Fardel demonstrates that a composite pane with the same basic structure as Manz's can achieve the desired performance levels at issue. Fardel at [0043], Table I.

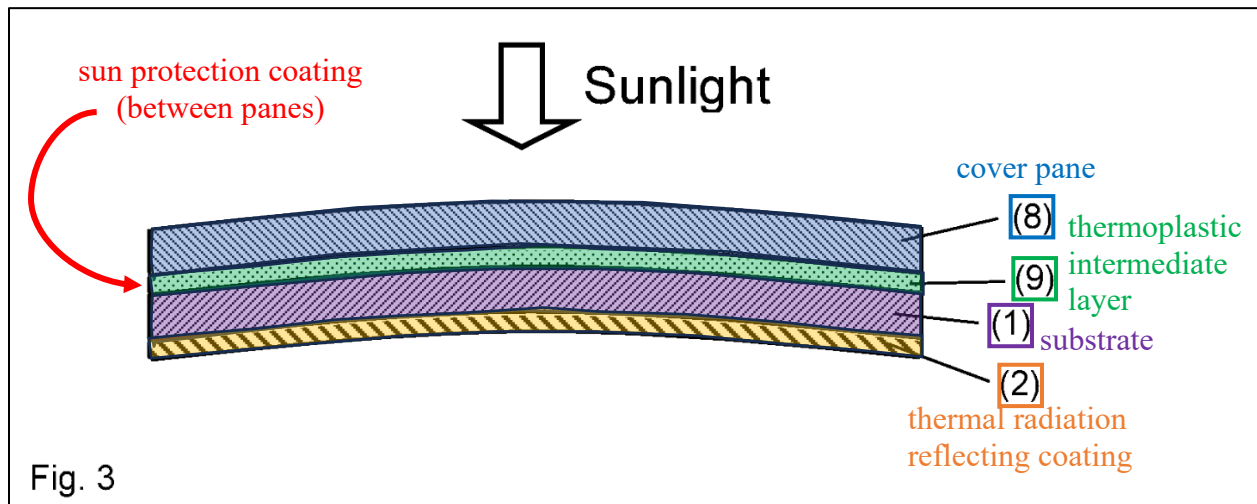
4. Claim 1

(a) Limitation 1[p]: A composite pane, comprising

104. The preamble of claim 1 recites what the claimed structure is—“a composite pane.” The Manz-Fardel Pane is a composite pane. Manz discloses that its substrate “is bonded to a cover pane via at least one thermoplastic intermediate layer” to form a composite pane. Manz at [0032], [0074], [0090]; FIG. 3.

- (b) *Limitation 1[a]: an outer pane having an outer-side surface and an interior-side surface, an inner pane having an outer-side surface and an interior-side surface, and a thermoplastic intermediate layer, which joins the interior-side surface of the outer pane to the outer-side surface of the inner pane*

105. Manz discloses an outer pane and an inner pane, each having an outer-side surface and an interior-side surface, joined by a thermoplastic intermediate layer:



Id. at [0062], [0080], [0090], FIG. 3 (annotated). Manz explains that “[t]he cover pane is intended to face the outside environment in the installed position of the composite pane, whereas the substrate faces the interior.” Manz at [0032]. Manz also recognizes that each pane has distinct surfaces, referring to “the surface of the substrate facing away from the cover pane,” “the surface of the substrate facing the cover pane,” and “the surface of the cover pane facing the substrate.” *Id.* at [0032],

[0062]. A POSITA would understand that Manz also discloses a surface of the cover pane facing away from the substrate.

- (c) *Limitation 1[b]: wherein the composite pane has, between the outer pane and the inner pane, at least one sun protection coating, which substantially reflects or absorbs rays outside the visible spectrum of solar radiation*

106. Manz discloses a sun protection coating between the outer pane and the inner pane that substantially reflects or absorbs rays outside the visible spectrum of solar radiation. Manz discloses that “[a] sun protection coating is further applied on the surface of the substrate facing the cover pane, on the surface of the cover pane facing the substrate, or on a carrier film in the thermoplastic intermediate layer.” Manz at [0062]. The sun protection coating “reflects fractions of the incident sunlight outside the visible spectral range, in particular in the infrared spectral range” and “preferably comprises at least one metallic layer based on silver or a silver-containing alloy.” *Id.*

- (d) *Limitation 1[c]: wherein the composite pane has, on the interior-side surface of the inner pane, a thermal-radiation-reflecting coating (low-E coating)*

107. Manz discloses “at least one thermal radiation reflecting coating at least on the interior-side surface of the substrate.” Manz at [0008]. The functional layer of the coating “has reflecting properties for thermal radiation, in particular infrared radiation, yet is largely transparent in the visible spectral range.” *Id.* at [0036]. As a

result, the coating, in the summer, “reduces the emission of long-wave thermal radiation of a heated pane into the vehicle interior” and, in the winter “reduces the outward emission of heat from the interior into the external surroundings.” *Id.* at [0003], [0013]. This coating is generally installed “on the surface of a pane facing the interior,” which a POSITA would understand is the same as the interior-side surface of the inner pane required in the claim. Manz at [0003]; *see also* Manz at [0008], [0090]; FIG. 3.

(e) *Limitation 1[d]: wherein the thermal-radiation-reflecting coating contains a transparent conductive oxide*

108. Manz’s thermal radiation reflecting coating “contains at least one transparent, electrically conductive oxide (TCO)” and “preferably contains at least indium tin oxide (ITO).” Manz at [0036]; *see also id.* at [0008], [0063]. A POSITA would understand the TCO in the functional layer of the coating to be a transparent conductive oxide.

(f) *Limitation 1[e]: the composite pane has light transmittance $TL_{\text{composite glass pane}}$ of 1% to 12%*

109. The Manz-Fardel Pane has a $TL_{\text{composite glass pane}}$ of 1% to 12%, as recited in Limitation 1[e]. Manz discloses that its composite pane “has, according to the invention, transmittance in the visible spectral range of less than or equal to 5%.” Manz at [0035]. Manz’s range of light transmittance (less than 5%) overlaps with the claimed $TL_{\text{composite glass pane}}$ range of 1% to 12%. Manz further discloses one

embodiment of a composite pane with a low-E coating that has a transmittance (T_L) of 2.2% because it has an interior-side reflection (R_L) of 2.0% and a T_L/R_L ratio of 1.1. Manz at [0091]. Fardel further confirms that achieving light transmittance within the claimed range was a known design target, reporting an assembled glazing light transmittance of 6.7%. Fardel at [0043], Table I; *see also* Fardel at [0046] (targeting T_L “less than 8%” to “avoid introducing lighting conditions that could cause glare”).

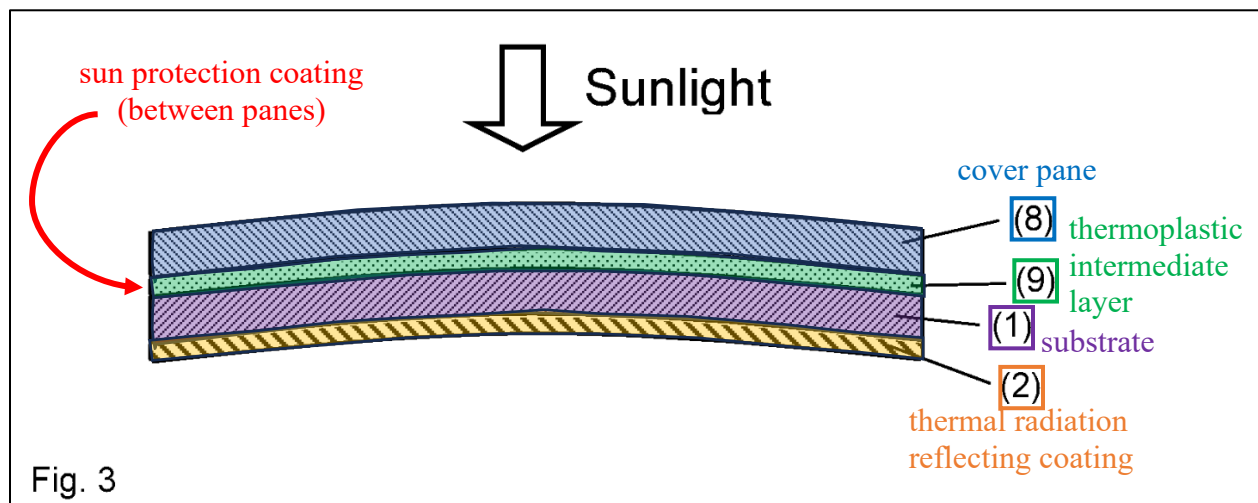
- (g) ***Limitation 1[f]: the composite pane has a transmittance index A of 0.02 to 0.08, wherein the transmittance index A is determined according to the following formula (I) $A = TL_{\text{composite glass pane}} / (TL_{\text{low-E-coated pane}} * TE)$ (I), where TL is the light transmittance and TE is the energy transmittance measured according to ISO 9050***

110. As discussed above in Sections VI and VII.A.4(g), transmittance index A is a fabricated mathematical relationship between three well-understood and measurable properties of the composite pane:

$$A = \frac{TL_{\text{composite glass pane}}}{(TL_{\text{low-E-coated pane}} \times TE)}$$

’037 Patent at 2:31–41, claim 1. Each of the three parameters in the transmittance index A formula is independently recognized as affecting specific, well-understood design outcomes for vehicle roof glazings: occupant visual comfort, thermal performance, and sunshade elimination.

111. Furthermore, Manz discloses the same physical structure of the composite pane disclosed by the '037 Patent and recited in claim 1—an outer pane (“cover pane”), an inner pane (“substrate”), a thermoplastic intermediate layer, a thermal radiation reflecting coating on the interior-side surface of the inner pane, and a sun protection coating between the outer and inner panes:

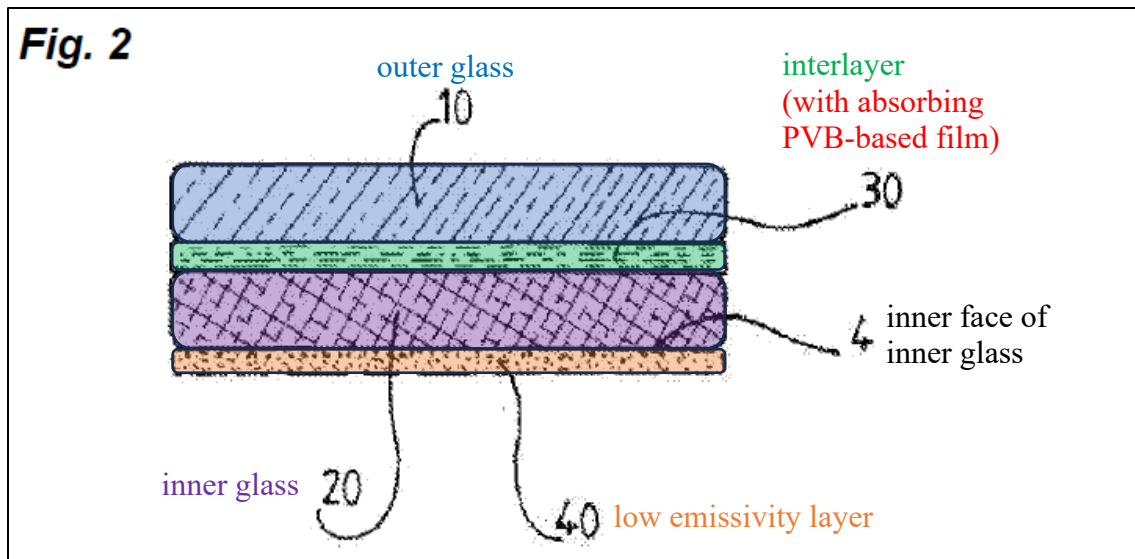


Manz at [0062], [0080], [0090], FIG. 3 (annotated). Notably, Manz shares the same applicant and a named inventor as the '037 Patent, but the priority patent application for Manz was filed nearly five years before the earliest priority patent application for the '037 Patent. *Compare* Manz at cover, *with* '037 Patent at cover. In other words, the claimed physical structure was well-known in the art before the priority date of the '037 Patent.

112. Also, Manz targets a composite pane with low light transmittance that uses a thermal radiation reflecting coating that “improves not only the thermal comfort in the interior of the motor vehicle, but also acts as an antireflection

coating.” Manz at [0091]; *see also* Manz at [0027]. The low light transmittance can be achieved by tinting or coloring the substrate, the cover layer, and/or the thermoplastic intermediate layer. Manz at [0035]; *see also* Manz at [0090], [0091]. A POSITA, reading Manz, would understand how to achieve improved thermal comfort without impairing vision by using tinted panes that would decrease light and energy transmittance. *See* '037 Patent at 4:16–22 (“[T]he corresponding values can be suitably selected by the person skilled in the art to achieve a transmittance index A according to the invention.”). Such optimization would naturally yield values for $TL_{\text{composite glass pane}}$, $TL_{\text{low-E-coated pane}}$, and TE that produce a calculated transmittance index A within the claimed range of 0.02 to 0.08, as disclosed in Fardel.

113. Further, Fardel discloses a very similar composite pane structure as Manz, comprising an outer glass, an inner glass, a PVB intermediate layer, a sun protection mechanism between the inner and outer panes, and a low-emissivity layer on the inner face (face 4) of the inner glass:



Fardel at [0011], [0035], [0037], FIG. 2 (annotated). Like Manz, Fardel’s objective is to develop a high thermal performance roof that can eliminate the need for the retractable sunshade (“blackout blind”). Fardel at [0008], [0052]. Fardel teaches that high thermal performance can be achieved using a light transmittance “allowing the elimination of the blackout without inconvenience to the users,” and specifies that a light transmittance “less than 8% should be chosen, so as to avoid introducing lighting conditions that could cause glare.” Fardel at [0046]. This low light transmittance can be achieved using “the glass with the lowest energy performance (expressed by the ET coefficient) while maintaining sufficiently high optical performance (expressed by the LT coefficient) in order to achieve the desired results on the final assembled glazing.” Fardel at [0033]. To further minimize energy transmittance, Fardel discloses a combination of absorbing PVB and a low-emissivity layer that blocks infrared radiation with wavelengths longer than 1.3 μm

and prevents the re-radiation of absorbed heat into the passenger compartment. Fardel at [0050], FIG. 3.

114. Fardel teaches a POSITA to minimize energy transmittance as aggressively as possible, subject to the constraint that light transmittance of the composite pane must remain high enough for the glazing to still be transparent. This is the essence of Fardel’s “selectivity” performance indicator—maximizing “the ratio of light transmission to energy transmission LT/ET.” Fardel at [0030], [0036]. A POSITA designing a vehicle roof would pursue the lowest achievable TE through the combination of well-known and predictable components, as disclosed by Fardel, i.e., tinted glass, absorbing PVB, sun protection coatings, and a low-E layer.

115. Fardel also discloses more detailed characteristics of its composite pane, along with the measurable properties used to evaluate thermal and visual performance. For example, in Table I, Fardel discloses a composite pane along with light transmission (LT) and energy transmission (ET) values for the entire composite pane and the individual panes:

Table I

Component	Nature
Exterior glass 10	2.1mm thick gray tinted glass LT = 29% and ET = 25%
PVB acoustic absorbent 30	PVB Sekisui © SSF thickness 0.76mm
Interior glass 20	Clear glass thickness 2.1 mm LT = 29% and ET = 25%

(continued)

Component	Nature
Low-emissivity layer 40	Emissivity 0.20
Assembled glazing	LT = 6.7%; ET = 4.2%; g = 19.2%; TTF = 3.77%; 124 W/m ²
Tinted “sky” reference	LT = 24.0%; ET = 14.9%; g = 35.7%; TTF = 15.5%; 254 W/m ²

where:

LT: luminous transmission under illuminant D65 (see ISO 9050),

ET: energy transmission, with “Moon Air Mass” = 2, according to ISO 9050 standard (“Moon Air Mass” being the air mass as defined by P. Moon),

g: solar factor according to ISO 9050 standard (Air mass 1.5),

TTF: as defined by Hisashi Ogawa, Tatsuya Noguchi, Takashi Muromachi, Harunori Murakami, NIPPON SHEET GLASS Co., Ltd, and Transmitted power (in W/m²): under external radiation according to illuminant D65 of 1000 W/m².

Fardel at Table I. In particular, Table I reports that the gray tinted exterior glass has a LT = 29% and ET = 25%, the clear interior glass with low emissivity layer has a LT = 29% and ET = 25%,¹¹ and the entire composite pane has a LT = 6.7% and ET = 4.2%. *Id.* Fardel also states that these transmittances are measured according to ISO 9050. *Id.* A POSITA configuring Manzt’s composite pane for use as a roof panel would have had every reason to optimize its components to have parameters consistent with Fardel’s teachings to achieve a configuration with “high thermal performance.”

116. Applying Fardel’s values to the equation of claim 1 results in a calculated index A of 0.055, which is near the middle of the claimed range of 0.02 to 0.08:

¹¹ The clear inner glass has a lower light transmittance because the low emissivity layer is tinted. *See* Fardel at [0013] (“[T]he outer glass and the inner glass can be clear glass, if the low-emissivity coating is itself tinted.”); Fardel at [0038] (“The inner glass 20 is, unlike the outer glass, rather a clear glass which, once coated with the low emissivity layer, will behave like tinted glass.”).

TL_{composite glass pane} (%)	TL_{low-E-coated pane} (%)	TE (%)	Index A¹²
6.7	29	4.2	0.055

Fardel at Table I.

5. ***Claim 2: The composite pane according to claim 1, wherein light reflectance at the interior-side surface of the inner pane at an angle of 8° is less than 6%***

117. As discussed in Section VII.A.5 (Ground 1A, Claim 2), Manz discloses that adding its low-E coating to a composite pane results in a reflectivity of less than 6% at incidence angles between 0° and 45°. For example, Manz discloses that, at a 45° angle, “[t]he interior-side reflection R_L is reduced to 2.0% by the coating 2.” Manz at [0091]. A POSITA would understand the reflectivity necessarily decreases at smaller incidence angles, and the reflectivity at 8° would be less than 2.0%. *See* Manz at FIGS. 4–7.

6. ***Claim 3: The composite pane according to claim 1, wherein the sun protection coating comprises a layer system with at least one metal layer embedded between dielectric oxide or nitride layers***

118. As discussed in Section VII.C.4(c) (Ground 2A, Limitation 1[b]), Manz’s sun protection coating “preferably comprises at least one metallic layer based on silver or a silver-containing alloy” with “two or three functional layers that

¹² Calculated by using Fardel’s values in Table I in claimed formula for transmittance index A.

are separated from each other by dielectric layers.” Manz at [0062]. A POSITA would understand that the metallic layer is embedded between the dielectric layers, which include dielectric oxide.

7. *Claim 4: The composite pane according to claim 1, wherein the sun protection coating is applied directly to the interior-side surface of the outer pane*

119. Manz discloses three alternative locations for the sun protection coating, including “on the surface of the cover pane facing the substrate.” Manz at [0062], claim 7. A POSITA would understand the sun protection coating is being applied directly to the interior-side surface of the outer pane.

8. *Claim 5: The composite pane according to claim 1, wherein the sun protection coating is arranged on a carrier film embedded in the intermediate layer*

120. Manz discloses three alternative locations for the sun protection coating, one of which is “on a carrier film in the thermoplastic intermediate layer.” Manz at [0062]. A POSITA would understand the sun protection coating is being embedded in the intermediate layer.

9. *Claim 6: The composite pane according to claim 1, wherein the intermediate layer is formed from at least one polymer film*

121. Manz discloses that “[t]he thermoplastic intermediate layer preferably contains thermoplastic plastics, for example, polyvinyl butyral (PVB), ethylene vinyl acetate (EVA), polyurethane (PU), polyethylene terephthalate (PET), or

multiple layers thereof.” Manz at [0034]; *see also* Manz at [0090]. A POSITA would have understood that PVB, EVA, PU, and PET are each polymer films.

10. Claim 7: The composite pane according to claim 6, wherein the at least one polymer film has light transmittance of 2% to 80%

122. As discussed in Section VII.C.4(f) (Ground 2A, Limitation 1[e]), Manz discloses achieving lower light transmittances by several approaches, including a thermoplastic intermediate layer that “can alternatively or additionally also be colored and/or tinted.” Manz at [0035]; *see also* Manz at [0090], [0091]. Manz further discloses that “[t]he thermoplastic intermediate layer preferably has transmittance from 20% to 80%,” and, in one embodiment, had a transmittance of 23%. *Id.* at [0035], [0091]. Additionally, tinted thermoplastic intermediate layers with light transmittances below 80% were commercially available prior to the TOI. Barton-001 describes using “body-tinted PVB” from Sekisui Chemical Co. Ltd. and E.I. du Pont de Nemours that has a visible light transmission of 18%. Barton-001 at [0068]. Similarly, Barton-246 discloses using tinted PVB with 35% and 18% light transmittance from Solutia Inc. Barton-246 at 10:40–44.

123. Accordingly, a POSITA utilizing a tinted intermediate layer or polymer film to achieve a lower light transmittance for the composite pane would involve routine experimentation that includes commercially available tinted PVB with light transmittances below 80%, with predictable results.

- 11. Claim 8: The composite pane according to claim 1, wherein the thermal-radiation-reflecting coating contains indium tin oxide, antimony-doped or fluorine-doped tin oxide and/or aluminum-doped zinc oxide (ZnO:Al) and/or gallium-doped zinc oxide (ZnO:Ga)**

124. As discussed above in Section VII.A.11 (Ground 1A, Claim 8), Manz discloses a low-E coating that contains indium tin oxide, antimony-doped or fluorine-doped tin oxide, aluminum-doped zinc oxide, and/or gallium-doped zinc oxide. Manz at [0036].

- 12. Claim 9: The composite pane according to claim 1, wherein the inner pane together with the thermal-radiation-reflecting coating applied thereto has light transmittance $TL_{\text{low-E-coated pane}}$ of 25% to 95%**

125. As discussed in Section VII.C.4(g) (Ground 2A, Limitation 1[f]), Fardel's Table I reports $LT = 29\%$ for the inner glass with low emissivity layer. Fardel at [0043] Table I.

- 13. Claim 10: The composite pane according to claim 1, which has light transmittance $TL_{\text{composite glass pane}}$ of 2% to 10%**

126. As discussed above in Section VII.C.4(f) (Ground 2A, Limitation 1[e]), Manz and Fardel disclose a light transmittance of 1% to 12% for the composite pane. Manz at [0035], [0091]; Fardel at Table I.

- 14. Claim 11: The composite pane according to claim 1, wherein the inner pane with the thermal-radiation-reflecting coating applied thereto has light reflectance at an angle of 8° of less than 6%**

127. As discussed in Section VII.C.5 (Ground 2A, Claim 2), Manz discloses that adding its low-E coating to a composite pane results in a reflectivity of less than 6% at incidence angles between 0° and 45° . Manz at [0091], FIGS. 4–7.

- 15. Claim 12: The composite pane according to claim 1, wherein the transmittance index A with light transmittance of the intermediate layer of 5 to 20%, with light transmittance of the intermediate layer of 20 to 25%, with light transmittance of the intermediate layer of 25 to 30%, and with light transmittance of the intermediate layer of more than 30% is in a range from 0.07 to 0.08**

128. As discussed in Section VII.C.10 (Ground 2A, Claim 7), Manz discloses achieving lower light transmittances using a thermoplastic intermediate layer that “can alternatively or additionally also be colored and/or tinted.” Manz at [0035]; *see also* Manz at [0090], [0091]. Manz further discloses that “[t]he thermoplastic intermediate layer preferably has transmittance from 20% to 80%,” and, in one embodiment, had a transmittance of 23%. *Id.* at [0035], [0091].

129. Further, as discussed above in Section VII.C.4(g) (Ground 2A, Limitation 1[f]), Fardel’s Table I embodiment inherently produces a transmittance index A of 0.055. Claim 12 narrows the transmittance index A to a range of 0.07 to 0.08. The difference corresponds to selecting a slightly darker inner pane, for example, which will decrease the denominator of the formula, resulting in a larger index A. This is not a different type of design choice. It is the same design choice pushed incrementally further in the same direction that the prior art teaches.

130. A POSITA with Fardel’s 29% $TL_{\text{low-E-coated pane}}$ embodiment as a starting point would naturally explore darker inner glasses to improve thermal performance. This is the type of routine optimization that would be expected in the art. The claimed index A range of 0.07 to 0.08 is the inherent, mathematically determined

consequence of the continued routine optimization of three well-known, independently result-effective design variables.

16. Claim 13: The composite pane according to claim 1, wherein the outer pane and/or the inner pane have a thickness of 0.5 mm to 4 mm

131. Manz discloses that “the substrate and, optionally, the cover pane preferably have a thickness from 1.0 mm to 25 mm and particularly preferably from 1.4 mm to 4.9 mm.” Manz at [0033]. Manz’s FIG. 3 embodiment uses a substrate with a thickness of 2.1 mm and a cover pane with a thickness of 2.1 mm. Manz at [0090]. Fardel likewise discloses glass pane thicknesses within the claimed range. Table I, in particular, specifies a 2.1 mm exterior glass and a 2.1 mm interior glass. Fardel at Table I; *see also id.* at [0020], [0021].

17. Claim 15: A method comprising utilizing composite pane according to claim 1 as a roof panel of a vehicle

132. Manz discloses that its composite pane with low visible-light transmittance “is intended as a roof panel for a motor vehicle.” Manz at [0090]; *see also id.* at [0075]. Fardel is likewise expressly directed to “high thermal performance glazing for a vehicle, in particular for a motor vehicle roof.” Fardel at [0001], [0008].

18. Claim 16: The composite pane according to claim 1, wherein the at least one sun protection coating substantially reflects or absorbs infrared rays

133. As discussed in Section VII.C.4(c) (Ground 2A, Limitation 1[b]), Manz discloses that “[t]he sun protection coating reflects fractions of the incident sunlight outside the visible spectral range, in particular in the infrared spectral range.” Manz

at [0062]. Manz further explains that “[b]y means of the sun protection coating, the heating up of the interior by direct sunlight is reduced.” *Id.*

19. Claim 17: The composite pane according to claim 3, wherein the at least one metal layer embedded between dielectric oxide or nitride layers is at least one metallic silver layer

134. As discussed in Section VII.C.6 (Ground 2A, Claim 3), Manz discloses that the sun protection coating “preferably comprises at least one metallic layer based on silver or a silver-containing alloy with a thickness from 5 nm to 25 nm.” Manz at [0062].

20. Claim 18: The composite pane according to claim 6, wherein the at least one polymer film contains polyvinyl butyral, ethylene vinyl acetate, polyurethane, and/or mixtures thereof and/or copolymers thereof

135. As discussed in Section VII.C.9 (Ground 2A, Claim 6), Manz discloses that “[t]he thermoplastic intermediate layer preferably contains thermoplastic plastics, for example, polyvinyl butyral (PVB), ethylene vinyl acetate (EVA), polyurethane (PU), polyethylene terephthalate (PET), or multiple layers thereof.” Manz at [0034].

21. Claim 19: The composite pane according to claim 7, wherein the at least one polymer film has light transmittance of 8% to 36%

136. As discussed in Section VII.C.10 (Ground 2A, Claim 7), Manz discloses achieving lower light transmittances by several approaches, including a thermoplastic intermediate layer that “can alternatively or additionally also be colored and/or tinted.” Manz at [0035]; *see also* Manz at [0090], [0091]. Manz

further discloses that “[t]he thermoplastic intermediate layer preferably has transmittance from 20% to 80%,” and, in one embodiment, had a transmittance of 23%. *Id.* at [0035], [0091].

D. Ground 2B –Claims 14 and 20 in view of Manz, Fardel, and Boote

1. Motivation to Combine Boote with Manz & Fardel

137. A POSITA would have been motivated to embed Boote’s switchable film assembly in the thermoplastic intermediate layer of the Manz-Fardel Pane, hereinafter referred to as the “Manz-Fardel-Boote Pane.”

138. Boote, Manz, and Fardel are all directed to laminated glazing structures for use in motor vehicles. Manz discloses its composite pane is “intended as a roof panel for a motor vehicle.” Manz at [0090]. Fardel is directed to “high thermal performance glazing for a vehicle, in particular for a motor vehicle roof.” Fardel at [0001]. Boote discloses that its glazing “may be used as a vehicle window such as a rooflight.” Boote at 11:31–33. A POSITA would have recognized that embedding Boote’s SPD switchable film assembly in Manz’s intermediate layer would allow the occupant to electrically control light transmittance, supplementing the benefits of Manz’s sun protection coating and low-E coating.

139. Boote also discloses a laminated glazing combining a switchable SPD film assembly with low emissivity and solar control coatings on the glass panes—a configuration directly analogous to adding Boote’s switchable element to the Manz-

Fardel combination. Boote at 10:4–12, FIG. 8. A POSITA would have had a reasonable expectation of success because Boote demonstrates successful lamination of SPD film assemblies between glass plies using PVB interlayers, which is the same polymer film material used in Manz’s composite pane. Boote at 9:54–10:4; Manz at [0090].

2. *Claim 14: The composite pane according to claim 1, wherein a functional element with electrically controllable optical properties is embedded in the intermediate layer*

140. As discussed in Section VII.B.3 (Ground 1B, Claim 14), Boote discloses an SPD film assembly that is laminated between PVB interlayer plies positioned between two glass plies of a composite pane. Boote at 9:54–10:4, FIG. 8; claim 9.

3. *Claim 20: The composite pane according to claim 14, wherein the functional element with electrically controllable optical properties is a PDLC element or an SPD element*

141. As discussed in Section VII.B.4 (Ground 1B, Claim 20), Boote discloses an SPD film assembly within a composite pane. Boote at 1:30–35; 9:54–61.

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

Dated: August 20, 2026

By: Steven A. Carlson

Steven A. Carlson