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D E C I S I O N
of 7 October 2003

Case Number: T 0378/01 - 3.5.1

Application Number: 93103909.3

Publication Number: 0561272

IPC: H01Q 1/12

Language of the proceedings: EN

Title of invention:
Transparent window antenna

Patentee:
PPG Industries Ohio, Inc.

Opponent:
Pilkington Holding GmbH

Headword:
Transparent window antenna/PPG INDUSTRIES

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0378/01 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 7 October 2003

Appellant: (Proprietor of the patent)	PPG Industries Ohio, Inc. 3800 West 143rd Street Cleveland OH 44111 (US)
Representative:	Sternagel, Hans-Günther, Dr. Sternagel, Fleischer, Godemeyer & Partner Patentanwälte Braunsberger Feld 29 D-51429 Bergisch Gladbach (DE)
Respondent: (Opponent)	Pilkington Holding GmbH Rotthauser Strasse 123 D-45884 Gelsenkirchen (DE)
Representative:	Tönhardt, Marion, Dr. Forrester & Boehmert Pettenkoferstrasse 20-22 D-80336 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted 5 February 2001 revoking European patent No. 0561272 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: S. V. Steinbrener
Members: R. Randes
B. J. Schachenmann

Summary of Facts and Submissions

I. This is an appeal of the proprietor against the decision of the Opposition Division to revoke European patent EP 0 561 272 because the subject-matter of granted claim 1 did not involve an inventive step in view of the document

E7: JP-A-02-082701.

In the decision the following documents were also mentioned:

E1: DE-A-26 35 217

E2: US-A-5 017 933

E3: DE-A-20 14 643

E4: EP-A-0 332 898.

II. Granted claim 1 reads as follows (the numbered inserts in brackets have been introduced by the Board and are used later on in the present decision):

"A slot antenna formed in association with a metal sheet (18) **[insert 1]** having an inner metal edge (20) defining an aperture which is closed by a non-conductive, optically transparent window (12) extending across the aperture **[insert 2]**, the antenna including:

(a) an electrically conducting, optically transparent panel (16,46,70) bonded to the window (12) and having an outer peripheral edge (22) spaced from

said inner metal edge (20) to define a polygonal antenna slot (24) between the edges (20, 22);

(b) an unbalanced transmission line having a grounded conductor (26) and an ungrounded conductor (30,54,72) coupled respectively to interfacing sides of the slot (24), the grounded conductor (26) being coupled to the metal sheet (18) near said inner metal edge (20),

characterized by

(c) a coupling metallic layer (52, 62), generally parallel to and spaced from the electrically conducting, transparent panel (16, 46, 70) by an interposed dielectric layer (44, 68) and positioned near the oppositely facing peripheral edge of the conducting, transparent panel (16, 46, 70) across the slot (24) from the grounded conductor (26), the coupling metallic layer (52, 62) having an area interfacing the optically transparent conducting panel (16, 46, 70) selected to provide a capacitance between the coupling metallic layer (52, 62) and the optically transparent conducting panel (16, 46, 70) which impedance matches the slot antenna to the transmission line by minimizing net reactance, the ungrounded transmission line conductor (30, 54, 72) being connected to the coupling metallic layer (52, 62) to capacitively couple the ungrounded conductor (30, 54, 72) to the transparent conducting panel (16, 46, 70) **[insert 3]**".

III. The **proprietor appealed**, requesting in the statement of grounds of appeal that **the patent be maintained on the basis of claim 1 as granted**. The appellant argued that the Opposition Division had not interpreted the teaching of document E7 properly and had seen features therein which were, in fact, not present.

IV. **The respondent (opponent)** disagreed with the opinion of the appellant (proprietor) and **requested that the appeal be dismissed**. The appellant with a letter dated 28 June 2002 filed **an auxiliary request (auxiliary request I)**, according to which claim 1, in relation to granted claim 1, had been clarified in that inserts 1 and 2 had been introduced (see above under II). **Insert 1** reads as follows:

"being a portion of a conductive body panel (14) of a vehicle (10)"

and **insert 2** reads as follows:

"the metal sheet extending at least several inches away from its inner metal edge to provide a substantial conductive surface".

V. In a **communication annexed to the summons to oral proceedings**, the Board expressed its preliminary opinion that an English translation of E7, which had been submitted by the Respondent before the first instance, but had formally not been introduced into the proceedings by the Opposition Division, should be introduced before the Board, since it was unsatisfactory that this Japanese patent application was to be interpreted with the aid of the very short

esp@cenet abstract which allegedly had been used by the Opposition Division in its interpretation. Only a complete translation of the original document appeared to be appropriate. The English translation filed by the opponent appeared to be such a complete translation of the Japanese document and nothing indicated that it might be incorrect. In particular, its correctness had not been contested by the appellant. The Board moreover expressed the opinion that, if E7 did indeed disclose a slot antenna, as alleged by the respondent, then the Opposition Division's decision appeared to be correct.

VI. With a letter dated 8 September 2003 the appellant filed **auxiliary request II and auxiliary request III.**

Claim 1 of **auxiliary request II** is differs from granted claim 1 (see point II above) in that **insert 1** (identical to insert 1 of the first auxiliary request, see point IV above) has been introduced (but not insert 2) and in that **insert 3** reads as follows:

",and

(d) for use in the AM and FM broadcast bands the width of the slot (24) is greater that 6,35 mm (one quarter inch) and not significantly greater than 25,4 mm (one inch)".

Claim 1 of **auxiliary request III** differs from granted claim 1 (see point II) in that **insert 1** (identical to insert 1 of auxiliary request I, see point IV above) has been introduced (but not insert 2) and in that **insert 3** reads as follows:

",and

(d) the window (12) comprising an interlayer (44, 68) laminated between two glazing plies (40, 42, 64, 66), wherein the transparent, conductive film panel (16, 46, 70) is laminated between the interlayer (44, 68) and one glazing ply (40, 64) and the coupling metallic layer (52, 62) is laminated between the interlayer (44, 68) and the other glazing ply (42, 66)".

VII. **In the oral proceedings**, held before the Board on 7 October 2003, the translation of document E7, filed by the respondent (see point V above), was introduced by the Board into the proceedings and used in the interpretation of E7.

The appellant's argumentation can be summarized as follows:

E7 shows different antennas formed by conductive layers 2 covering a glass pane 1 in a laminated structure. All of the examples shown in E7 concerned antennas which were formed on the windshield of a car. Figure 1 (and Figure 5) showed that almost the whole pane of a windshield was covered with a conductive layer. Along the edges of the four sides of that pane there was a narrow spacing without a conductive layer. This spacing had been interpreted by the respondent as a slot for a slot antenna. In the embodiments shown in Figures 2, 3 and 7 to 9 however different delimited parts of the windshield were used as antenna areas covered with a conductive film. The document contained no hint that the embodiments (Figures 1 and 6) having conductive layers and covering almost the entire pane could be

used as slot antennas. Moreover, Figures 2, 3 and 7 to 9 certainly did not show slot antennas; on the contrary, the antennas of Figures 7 to 9 were clearly formed as dipoles. Therefore, the embodiment of Figure 1 of the document was probably not intended to show a slot antenna. In fact, the spacing free from conductive layer had different widths along the different edges of the pane as could clearly be seen from the drawing filed by the respondent and showing the dimensions of the conducting layer and of the spacing free from conducting material along the pane sides according to Figure 1 of E7. A skilled man knew however that a varying slot width was not suitable for a slot antenna, since the properties of such an antenna were not predictable. Indeed it might well be that the spacing along the sides of the pane had to be covered or overlapped by the frame of the windshield when mounting it on the vehicle.

The antenna according to the present patent was moreover intended to be used for AM as well as FM reception and therefore had to be correspondingly designed. All the different antennas disclosed in E7 were apparently designed to be used for the reception of FM radio and for television, since no details were given about them as AM antennas. Table 1 in E7 showed that the capacitive coupling bars to the antenna functioned as bar antennas themselves and influenced the reception at the rear of the flat area antenna. Table 3 showed that the combination of a flat conductive surface antenna and a short capacitive coupling bar according to Figure 6(a) had the best reception of the combinations shown in Figures 6(a) to (c). The bars were of different lengths in these

Figures. The feeding point of the flat antenna in Figure 6(a) was positioned at the middle of the bar. The bars in the embodiments in Figure 6 were positioned on the inside of the glass pane having the flat antenna on the other side.

It followed from Table 3 of E7 (translation, page 5, after Table 3), relating to the different combinations of the antenna and a corresponding coupling bar shown in Figure 6, that an antenna and a corresponding coupling bar had to be seen as forming an antenna unit. This was similar to the reference cited in the opposition proceedings, document E2, which showed that an antenna consisting of bars could be divided up into two different parts, being positioned at different sides of a glass plate and connected via a feed pad or antenna terminal (E2, for example Figure 1, reference numeral 11).

Moreover the coupling bars shown in E7 had a very small width (2 mm was mentioned - see translation, page 3, first paragraph) and were also in the figures drawn as narrow lines. This was totally different to the invention, which required that the corresponding bar, i.e. the coupling metallic layer 52, 62, **had an area** to provide a desired capacitance between itself and the transparent conducting panel 46, 70 on the other side of an interposed dielectric layer. Thus the coupling metallic area according to the invention was really used to provide an adaptable impedance to match the antenna to the transmission line.

It appeared, in fact, that the coupling bars of various lengths shown in E7 were not varied to adapt the impedance, but principally to change the resonant frequency. It was normal to test bar antennas of different kinds in this way.

E7 contained no hint that the antennas described could be used as slot antennas. In particular, there was no discussion of how and where the grounded conductor of a coaxial cable should be connected to the antenna. Indeed such a conductor was not mentioned in the description or hinted at in the figures. This suggested that E7 did not concern slot antennas at all. It was, of course, true that the skilled man would know how to connect the coaxial cable to a slot antenna, as was also shown in E4 and the handbooks, representing the common general knowledge of a skilled person, mentioned by the respondent. However E4 was totally silent as to how to match the antenna to the transmission line. The approach proposed by the present patent was thus not common general knowledge, but instead an effective new solution to the problem of impedance matching and at the same time a solution to the problem of comfortably connecting the antenna to the interior of a vehicle.

The respondent's argumentation can be summarized as follows:

Having regard to the subject-matter of claim 1 of the main and the first auxiliary request, it appeared that all the features of claim 1 were disclosed in E7. If they were not considered to be explicitly disclosed, then they were to be considered to be implicit or obvious to a skilled person. It was true that E7 did

not state that the uncovered spacing along the edges of the pane represented a slot. A skilled person seeing the figures of E7 would however arrive at the conclusion that the antenna in Figure 1 must be a slot antenna. The dimensions given in E7 in respect of that antenna, applied very well to a slot antenna, if it was assumed that about 1 cm of the outermost area, along the edges, of the pane was used for adhering or mounting the pane to the frame of the windshield. In that case the dimensions of the uncovered spacing along the edges shown in Figure 1 of E7 corresponded to the dimensions of the slot given in claim 1 of the appellant's **auxiliary request II** (see point VI above).

It was also true that E7 did not show a coaxial cable for connecting the antenna. Connection of an antenna, also of a slot antenna, was however common general knowledge, which was confirmed by the handbooks referred to by the respondent. If the Board did not regard E7 as teaching a slot antenna, then the combination of E4 and E7 would nevertheless lead the skilled person to the subject-matter of claim 1 according to the main request (claim 1 as granted), since E4 (Figure 3) showed how a coaxial cable had to be connected to a slot antenna. A grounded conductor and an ungrounded conductor were coupled opposite to each other across the slot to respective interfacing sides of it, the grounded conductor being coupled to the metal frame. Thus E4 disclosed a conventional slot antenna, and document E7 taught how to use a dielectric coupling of the ungrounded conductor to capacitively connect the coaxial cable to the antenna and how to use this design to adapt the impedance so that it matched the slot antenna to the transmission line.

Having regard to the subject-matter of claim 1 of **auxiliary request III**, it appeared that feature (d) introduced into the claim [insert 3 of auxiliary request III], if not considered to be disclosed by, or obvious having regard to, E7, was known from document E3 (page 5, last paragraph).

VIII. The parties maintained their requests made before the oral proceedings.

Thus **the appellant (proprietor) requested** that the decision under appeal be set aside and that the patent be maintained as granted (main request) or in amended form on the basis of the claims filed as first auxiliary request with the letter dated 28 June 2002 or on the basis of the claims filed as second and third auxiliary request with the letter dated 8 September 2003.

The respondent (opponent) requested that the appeal be dismissed.

IX. At the end of the oral proceedings the Chairman announced the Board's decision.

Reasons for the Decision

1. The appeal satisfies the requirements mentioned in Rule 65(1) EPC and is thus admissible.

As can be seen from the **assessment of inventive step** below, the Board does not find the claimed invention anticipated by the available prior art.

2. *Inventive step*

2.1 Main request

The Board considers that document E4 (see embodiment shown in Figure 3), which is also mentioned in the introductory part of the present patent specification, represents the closest prior art, since it discloses a slot antenna according to the preamble of claim 1. E4 also discloses the generally known feature of slot antennas, that is to connect the grounded conductor near the edge of the metal sheet (34) and to connect the ungrounded conductor (33) across the slot from the grounded conductor to the conductive panel (30) near the edge of the panel. The connection of the conductors to interfacing sides of the slot in E4 is of mechanical or galvanic nature, i.e. the conductors are in direct galvanic contact with the metal sheet and the conductive panel, respectively. According to claim 1 however, the contact to the ungrounded conductor is capacitively arranged (near the edge of the conducting panel).

Having regard to the features of the characterising part of claim 1 and the prior art disclosed in E4, it appears to the Board that the problem to be solved can be seen in **connecting the slot antenna in a compact and mechanically secure way to the ungrounded conductor of the coaxial cable and appropriately matching it to the transmission line**.

The skilled person considering this problem would seek to use the teaching of document E7 to solve it. As has been argued by the respondents, Figure 1 of E7 discloses an antenna which, although not showing how the ungrounded conductor is connected to the conducting film panel, has the appearance of a slot antenna. Obviously, E7 discloses several types of antennas: bar antennas of different kinds, as well as antennas with larger areas. Thus it cannot be excluded that the antenna shown in Figure 1 could function differently in different modes. It is noted in this respect that the slot antenna according to E4 functions differently in FM and AM modes (Figure 3 to column 3, lines 30 to 36). Only in the FM mode it functions as a normal slot antenna. Hence the Board considers that the person skilled in the art recognizes that the antenna shown in Figure 1 of E7 could function as a slot antenna.

It is thus apparent to a skilled person that document E7 relates to conducting film antennas of different types mounted on a pane of a vehicle and that its teaching generally concerns an effective and simple way of connecting an ungrounded connector to a delimited conducting film or panel spaced from the edges on all sides of the pane. According to E7, Figure 1, the conducting panel is formed by a conducting film covering almost the whole surface of the inner (laminated) side of the outer windshield pane 1. The inner side of the pane 1 is covered with an intermediate layer of, for example, polyvinyl butyral and is bonded to the laminated side of pane 3 which has its other side turned to the inside of the vehicle. The

inner side of the pane 3 features a "**capacitive coupling bar**" 4 with a feeding point 5.

E7 therefore teaches to the skilled person that this way of coupling a conducting film or panel antenna to a coaxial cable avoids the galvanic and mechanically weak connection of the ungrounded connector to the thin film of the conducting panel. Also, the mere mention of a "capacitive coupling bar" would cause the skilled person to consider the teaching of document E7, since it is clear that the connection over a "capacitive coupling bar" must contribute to the matching of the antenna to the transmission line.

The Board is therefore of the opinion that the skilled person would combine the teachings of E4 and E7, thus arriving at the invention. The appellant has argued that the capacitive coupling bar 4 shown in E7 cannot be compared with the coupling metallic layer 67 according to the invention, since the bar is depicted as a very narrow line in all of the figures of E7. However to the Board it is clear that the bar 4 in E7 contributes to the capacitive coupling and in this sense has the same function as the coupling metallic layer, although it is quite narrow. In fact, the Respondent pointed out during the oral proceedings that the size of the area of the coupling bar in E7 (12 cm^2, see Figure 3 and the corresponding text, bar 4 having a length of 600 mm and page 3, line 2, the width of bar 4 being 2 mm) corresponded to that of the embodiment given in the present patent specification for the metallic layer (17,4 cm^2). It is, of course, self-evident for the skilled person, having regard to the teaching of E7, that the capacitive coupling for

different antennas and different types of antennas must be adapted and changed in the course of design to optimize performance. This measure is within the borders of the normal work of a skilled person and does not involve an inventive step pursuant to Article 56 EPC.

Hence the skilled person starting from the teaching of E4 would combine this teaching with that of E7, disclosing a "three-dimensional connection" between the conducting panel and the capacitive coupling bar. The skilled person would therefore connect the electrically conducting transparent panel in E4 via an interposed dielectric layer as shown in E7 (reference numerals 7 and 3) to a coupling metallic layer (corresponding to bar 4 in E7) which is connected to the ungrounded conductor and so arrive at the invention as set out in claim 1.

2.2 Auxiliary request I

Claim 1 of auxiliary request I only contains clarifications in respect of claim 1 of the main request. The Board has already considered the antenna according to claim 1 of the main request to be of a type as more clearly set out in claim 1 of the auxiliary request I. The closest prior art, disclosed in E4, concerns a slot antenna for a vehicle and the windshield is apparently surrounded by a sheet formed by a conductive body panel (Figure 3, 34). It moreover follows from common general knowledge and the definition of the slot antenna that the metal sheet must extend a certain distance from the slot (surely

"at least several inches away from its inner metal edge") to provide a substantial conductive surface.

Thus the subject-matter of claim 1 of the auxiliary request is obvious to a skilled man for the same reasons as the main request.

2.3 Auxiliary request II

Claim 1 of auxiliary request II (see point VI above) differs, in principle, from claim 1 of the main request only in that a range for the slot widths has been given for the antenna ("greater than" and "not significantly greater than") when used in the AM and FM broadcast bands.

It therefore appears to the Board that the subject-matter of claim 1, **additionally to the problem relating to claim 1 of the main request** (see point 2.1 above) **should provide a good reception both in the FM and the AM bands.**

The appellant has argued that the range given in the claim had been selected as a good compromise for reception in the FM as well as the AM bands. The problem of reception in these bands by a single slot antenna had not been touched on in any of the cited documents. The appellant, in particular, pointed out (see point VII) that the teaching of E7 did not show any measurements in AM bands.

The Board is however of the opinion that the selection of a range of slot widths for reception of both the FM and AM bands is a type of compromise that the skilled

person must always be prepared to make. It would be a quite normal task to perform the necessary measurements to arrive at a slot width range that is acceptable for the quality of reception in both bands. The Board also takes the view that the dimensions indicated in the drawing filed by the respondents representing the dimensions of the slot of Figure 1 of E7, in fact, correspond to the range of widths given in the claim, if, as proposed by the respondent, it is considered that about one cm at the sides of the pane is used for fixing the glass to the windshield frame of the vehicle.

It is true that E7 does show a slot around the window pane having different widths. In this respect however, it appears that claim 1 of auxiliary request II is not limited to a constant slot width either. Moreover, E1, which shows a slot antenna, discloses a slot along the sides of a car window which has different widths along its sides (E1, page 4, last paragraph). Thus it appears that a constant slot width would not be a crucial requirement of a slot antenna.

The Board is therefore of the opinion that the subject-matter of claim 1 of auxiliary request II is obvious to a skilled person.

2.4 Auxiliary request III

Claim 1 of auxiliary request III (see point VI above) differs from claim 1 of the main request by feature (d), which makes clear that the combination of the conductive film panel, the dielectric interlayer and the coupling metallic layer is laminated between two

panes. Starting from the teaching of document E4, it appears that the additional problem to be solved in addition to the problem relating to claim 1 of the main request can be seen in protecting the connection between the antenna and the coaxial cable from exterior damage.

This additional feature appears to be self-evident to a skilled man, since it is clear that the connection is mechanically better protected if it is covered with protective shields on both sides. If there is a window consisting of two or more glass panes it would be obvious to use them as protective shields. In this context the skilled person would also consider document E3 which is concerned with antennas for vehicle windows having inductive or capacitive matching means positioned directly on the antenna structure plate (pane). This document mentions, in particular, that the conductive contact sheets of the capacitive means could be positioned between the panes of a laminated window on both sides of an interlayer (see E3, page 5, last paragraph).

The Board is therefore of the opinion that the skilled person would arrive at the subject-matter of claim 1 in an obvious way by combining the teachings of the documents E4, E7 and E3.

2.5 The Board is thus of the opinion that the subject-matter of claim 1 of none of the main request or the auxiliary requests I to III involves an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Kiehl S. V. Steinbrener