BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS | BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE | CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 42/91 - 3.4.2

Application No.: 85 850 132.3

Publication No.: 0 162 821

Title of invention: Method and apparatus for measuring the level of a fluent material in a container

Classification: G01F 23/28

D E C I S I O N
of 1 April 1992

Proprietor of the patent: SAAB MARINE ELECTRONICS AKTIEBOLAG

Opponent: Autronica AS

Headword:

EPC Article 56

Keyword: "Main and auxiliary requests - no inventive step"
"Combination of document relating to the special field of the patent with textbook knowledge from the general field of the intended improvement"

Headnote

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 42/91 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 1 April 1992

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Decision under appeal :
Decision of Opposition Division of the European Patent Office dated 20 September 1990 and posted on 24 October 1990 revoking European patent No. 0 162 821 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : E. Turrini
Members : W.W.G. Hofmann
L.C. Mancini

Summary of Facts and Submissions

I. European patent No. 0 162 821 was granted on the basis of European patent application No. 85 850 132.3.

II. The patent was revoked by a decision of the Opposition Division on opposition by the Respondent, on the ground that its subject-matter did not involve an inventive step. During the opposition procedure, in particular the following documents were referred to:

(D1) "IEEE Transactions on Industrial Electronics and Control Instrumentation" vol.IECI-18, No.3 (1971), pages 85 to 92;

(D2) "International Organization of Legal Metrology", Second pre-draft International Recommandation (October 1983), pages 11 and 13;

(D3) "The Bell System Technical Journal" vol. XXXIII, No.6 (1954), pages 1209 to 1265;

(D8) A.E. Karbowiak: Trunk Waveguide Communication (1965), pages 54 to 59.

III. The Appellant (Patentee) lodged an appeal against this decision.

IV. In response to a communication from the Board, the Respondent cited the further document

(D9) "Enraf Nonius Delft sales aid" (June 1974), pages 1 to 9 and Figures 1 to 16.

V. Oral proceedings were held during which the Respondent cited the further documents

(D10) "The Bell System Technical Journal" (July 1958), pages 899 to 912; and

(D11) pages 84 to 93 of the book of A.E. Karbowiak mentioned above under the number (D8).

At the end of the oral proceedings, the Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of:

- Claims 1 to 10 (main request), and

- according to an auxiliary ("secondary") request, Claims 1 to 9 (secondary request),

all handed over at the oral proceedings.

The Respondent requested that the appeal be dismissed.

VI. Independent Claims 1 and 3 according to the main request now under consideration read as follows:

"1. Method of measuring the level of a fluent material in the form of oil products, some of which are clogging, in a container (1), with the use of a microwave signal that is fed out of a transmitter (14) through a tubular waveguide (7) that extends vertically downwardly through the container and communicates with it so that the surface (10) of the material in the waveguide follows the level of the surrounding material, and which signal is reflected by the surface back up through the waveguide and conducted to a receiver to be employed, after signal processing in an electronic unit, for determining the level of material in the container, which microwave signal has a wavelength several times smaller than the diameter of the waveguide

(7), c h a r a c t e r i z e d in that the waveguide (7) is an existing piper installed in the tank for housing a mechanical float measuring device, which waveguide (7) is circular, which waveguide (7) is provided with sufficiently large and closely spaced holes (9) along its length so that the interior thereof is communicating outwardly with the fluent material in the container, and in that the microwave signal is fed to the waveguide (7) by way of a mode generator (11) that produces substantially only one dominant propagation mode of the signal, which is rotationally symmetrical, namely the H_{01} mode."

"3. Apparatus for measuring the level of a fluent material in the form of oil or products, some of which are clogging, in a container (1), comprising a transmitter (14) for feeding a microwave signal though a tubular waveguide (7) that extends vertically downward through the container and communicates with it so that the material surface in the waveguide that reflects microwave signals follows the level of the surrounding material, a receiver for receiving the reflected microwave signal, and an electronic unit that is arranged to determine the material level in the container by employing the received signal, and having a mode generator (11) between the transmitter (14) and the waveguide (7), which waveguide (7) has a diameter several greater than the wavelength of the signal, c h a r a c t e r i z e d in that the waveguide is an existing pipe installed in the tank originally intended for housing a mechanical float measuring device, which waveguide (7) is circular, which waveguide (7) is provided with sufficiently large and closely spaced holes (9) along its length so that the interior thereof is communicating outwardly with the fluent material in the container (1), and in that said mode generator (11) between the transmitter (14) and the waveguide (7) is arranged to

produce substantially only one dominant rotationally symmetrical propagation mode of the signal, namely the H_{01} mode."

Claims 2 and 4 to 10 are dependent on Claims 1 and 3 respectively.

Independent Claims 1 and 2 according to the auxiliary request read as follows:

"1. Method of measuring the level of a fluent material in the form of oil products, some of which are clogging, in a container (1), with the use of a microwave signal that is fed out of a transmitter (14) through a tubular waveguide (7) that extends vertically downwardly through the container and communicates with it so that the surface (10) of the material in the waveguide follows the level of the surrounding material, and which signal is reflected by the surface back up through the waveguide and conducted to a receiver to be employed, after signal processing in an electronic unit, for determining the level of material in the container, which microwave signal has a wavelength several times smaller than the diameter of the waveguide (7), c h a r a c t e r i z e d in that the waveguide (7) is an existing pipe installed in the tank originally intended for housing a mechanical float measuring device, which waveguide (7) is circular, which waveguide (7) is provided with sufficient large and closely spaced holes (9) along its length so that the interior thereof is communicating outwardly with the fluent material in the container, and in that the microwave signal is fed to the waveguide (7) by way of a mode generator (11) that produces substantially only one dominant propagation mode of the signal, which is rotationally symmetrical, namely the H_{01} mode and in that the microwave signal is fed to the tubular waveguide (7) from the transmitter via a

conical diameter adaptor having the form of a funnel hung down in the waveguide (7)."

"2. Apparatus for measuring the level of a fluent material in the form of oil or products, some of which are clogging, in a container (1), comprising a transmitter (14) for feeding a microwave signal through a tubular waveguide (7) that extends vertically downward through the container and communicates with it so that the material surface in the waveguide that reflects microwave signals follows the level of the surrounding material, a receiver for receiving the reflected microwave signal, and an electronic unit that is arranged to determine the material level in the container by employing the received signal, and having a mode generator (11) between the transmitter (14) and the waveguide (7), which waveguide (7) has a diameter several greater than the wavelength of the signal, c h a r a c t e r i z e d in that the waveguide is an existing pipe installed in the tank originally intended for housing a mechanical float measuring device, which waveguide (7) is circular, which waveguide (7) is provided with sufficiently large and closely spaced holes (9) along its length so that the interior thereof is communicating outwardly with the fluent material in the container (1), and in that said mode generator (11) between the transmitter (14) and the waveguide (7) is arranged to produce substantially only one dominant rotationally symmetrical propagation mode of the signal, namely the H_{01} mode, and in that a conical diameter adaptor having the form of a funnel is provided and hung down in the waveguide (7) for feeding said microwave signal from said transmitter (14) to the tubular waveguide (7)."

Claims 3 to 9 are dependent on Claim 2.

VII. The arguments presented by the Appellant are in substance as follows.

The skilled person was confronted with the problem to convert an existing oil tank conventional fluid level measuring device into one where the fluid level was measured by means of microwaves. The skilled person would not have dared to use the old clogged and rusty stand pipe (which also had holes of various shapes) as a guide for the microwaves.

D1 only deals with laboratory experiments where the pipes are clean, have no undefined joints and no holes in the walls, so that the problem of the present invention was not before him. The holes in the walls of the standpipe are known per se (document D2), but not in connection with radar measurements. The first attempt of a skilled person to overcome the problem with the holes would have been to utilise the unsymmetrical H_{11} mode at a relatively low frequency since the H_{11} mode gives a fairly low current around the holes. However, it was found out in the present invention that the H_{01} mode is much less sensitive to clogging.

VIII. The Respondent's arguments can be summarised as follows:

Claims 1 and 3 of the patent in suit cover quite a broad scope of protection which is not limited to a particular shape and distribution of holes in the waveguide and to particular clogging of the waveguide. Moreover, the fact that the waveguide has holes, a circular cross-section and is overmoded, simply describes an existing situation in many storage tanks, where the skilled person wishing to convert its measuring system to radar measurement has no choice but is forced to use the stand pipe as it is.

The circular H_{01} mode is well known in the art to be the "low-loss mode" presenting particularly low wall currents. It is therefore not surprising that this mode is less sensitive than other modes to disturbing wall effects. Its use is therefore obvious. The properties of this mode, also under consideration of dielectric coatings on the walls, are described in D8.

The teachings of D1 go beyond mere laboratory work. The application to large storage tanks, to oil and petroleum, and the effects of pollution and corrosion are explicitly mentioned.

Reasons for the Decision

1. The appeal is admissible.

2. Claim 1 according to the main request differs from the granted Claim 1 (which essentially corresponds to the original Claim 1) by additional features concerning the fact that the fluent material is in the form of oil products some of which are clogging, that the waveguide is an existing pipe installed in the tank for housing a mechanical float measuring device, that the waveguide is circular, that the waveguide is provided with sufficiently large and closely spaced holes along its length so that the interior thereof is communicating outwardly with the fluent material in the container, and that the propagation mode of the signal is the H_{01} mode.

These features are originally disclosed on page 3, lines 6 and 7, page 3, line 25, page 8, lines 15 to 17, 22 and 23, Claim 4, and page 8, lines 10 to 14. They further restrict the scope of protection conferred.

The features of Claim 2 (which was first filed after grant) are originally disclosed on page 12, lines 15 to 20.

The features of apparatus Claim 3 correspond to those of Claim 1.

Independent Claims 1 and 2 according to the auxiliary request correspond to the above-mentioned Claims 1 and 3 according to the main request supplemented with the features of Claim 2 according to the main request.

Thus, no objections arise under Article 123(2) and (3) EPC.

3. Main request

3.1 Novelty

3.1.1 D1 describes a method of measuring the level of a fluent material corresponding to the pre-characterising portion of Claim 1. In particular, oil is mentioned on page 86, left-hand column, line 25, and wall depositions on page 89, left-hand column, lines 15 to 17. (Moreover, Claim 1 is not limited to the fact that the oil is clogging since the clogging is only brought in relationship with "some" of the oil products). The fact that the microwave signal should be chosen to have a wavelength several times smaller than the diameter of the waveguide, is mentioned on page 88, right-hand column, lines 34 to 37. In further correspondence with Claim 1 (characterising portion), the mode generator produces substantially only one dominant propagation mode of the signal (page 90, left-hand column, last three lines).

The interpretation of the feature in Claim 1 "that the waveguide is an existing pipe installed in the tank for housing a mechanical float measuring device" requires some comment: The claimed method is a **method of measuring** a certain quantity using a specific set-up. The way of production of this set-up and in particular the formerly intended purpose of some parts of this set-up during its production do not form part of the performance of the measurement and can therefore define the measuring method only insofar as the waveguide and its installation used for the measurement must be such that they could have been suitable for housing a mechanical float measuring device. There is no doubt that in principle any vertical overmoded guide for e.g. 10 GHz microwaves partially immersed in a liquid, as the one disclosed in D1, could have been suitable for housing such a mechanical float measuring device. Therefore, this feature cannot distinguish the claimed method from the teachings of D1.

However, in D1 the cross-section of the waveguide is only mentioned to be rectangular (e.g. page 89, line 7), and the modes H_{01} and H_{10} mentioned in D1 are consequently different from the circular H_{01} mode specified in Claim 1. Moreover, no holes along the length of the waveguide are shown in D1.

3.1.2 The other cited documents do not come closer to the claimed subject-matter. In particular, D3 and D8 relate to the transmission of guided microwaves without, however, mentioning the measurement of the level of fluent material. D9 shows stand pipes of oil tanks provided with sufficiently large and closely spaced holes along their length so that the interior thereof is communicating outwardly with the fluent material in the container. However, it does not mention microwave measurements.

3.1.3 The subject-matter of Claim 1 is therefore novel in the sense of Article 54 EPC.

The same is true for Claim 3 the features of which correspond to those of Claim 1. (The arguments stated above in point 3.1.1 regarding the meaning of the feature "existing pipe installed in the tank originally intended for housing a mechanical float measuring device" apply mutatis mutandis to the corresponding features in the apparatus claim 3 since the way of production and the intended purpose of the set-up do not directly define the claimed apparatus.)

3.2 Inventive step

3.2.1 Starting from the disclosure of D1 the objective problem solved by the remaining features of Claim 1 is twofold and apparent from said remaining features: On the one hand, the holes along the length of the waveguide serve the sufficient communication of the fluent material inside and outside of the waveguide. On the other hand, the circular shape of the waveguide and the use of the circular H_{01} mode serve the purpose of keeping within acceptable limits the influence of the holes and of a reasonable mass of rust or oil coating on the accuracy of the measurement (column 2, lines 41 to 43, column 3, line 63 to column 4, line 3, and column 4, lines 28 to 31 of the patent specification).

It is evident that the measured level of liquid in the waveguide represents the level of the liquid in the container only if there is communication between the liquid inside and outside of the waveguide, and good accuracy under a variety of conditions is quite generally the aim of any measurement. Thus, finding the stated problem does not per se involve an inventive step.

3.2.2 How large and closely spaced the holes along the length of the waveguide have to be, is actually left open in Claim 1 since communicating fluid levels can in principle be achieved by one hole at the lower end and one hole at the upper end of the waveguide, and the necessary size of the holes and the necessity of further holes along the length depend very much on the specific nature of the oil product which is not any further defined in Claim 1. In any case, if the communication of the fluid levels is not satisfactory, an expert will readily provide further openings along the pipe, as is e.g. shown in D9.

3.2.3 The properties of the circular H01 mode are well known in the art of microwaves. From D3 (cf. in particular pages 1213 to 1215) as well as from D8 (cf. in particular pages 56 and 57) it can be seen that the circular H_{01} mode is the "low-loss" mode in which (especially for wavelenghts several times smaller than the diameter of the waveguide, as already proposed in D1) the wall currents are particularly low. This means that in this mode not only the attenuation of the wave is particularly low, but also the influence of changes of the impedance of the wall (D8, pages 56 and 57). Thus, a skilled person could expect that the use of this mode would be advantageous with regard to the effects of the holes in the walls and possible oil coatings.

The Board does not agree with the argument of the Appellant that the skilled person would have primarily tried the H_{11} mode. On the average, the wall currents of the H_{11} mode are considerably higher than those of the H_{01} mode, and it could not be assumed that the position of all the possible sources of impedance (holes as well as clogging material) would coincide with the position of the single low wall current plane of the H_{11} mode.

It is remarked that in the view of the Board a person occupied with improving the microwave measurement system of an oil container can be expected to have knowledge of the basic facts of microwave propagation as those taught in the comprehensive article D3 and textbook D8.

Modifying the method according to D1 in such a way that the circular H_{01} mode and consequently a circular waveguide are used, is therefore considered to be obvious for a person skilled in the art.

3.2.4 The Appellant has argued that a person skilled in the art would not have realised that in the usual oil tanks which already comprise a stand pipe for mechanical float measurement of the oil level and which after years of use are rather rusty and clogged, this original stand pipe itself could be used as a waveguide when converting the tank to microwave level measurement. Apart from the fact that these features - as already stated in point 3.1.1 above - are not defined in Claim 1, this argument also does not convince the Board for another reason: D1 already relates to the oil level measurement in oil tanks with the aid of a waveguide immersed in the tank, taking film depositions, corrosion and pollution into account. There is no reason why a skilled person should assume that such a presumably new waveguide as described in D1 and adapted to all the requirements of a level gauging pipe in an oil tank would, after years of use, look much different from a stand pipe which had already existed in the tank for other level measurements. Thus, he would realise that he could just as well use the pipe which already existed since he would have to take the different impairments of the pipe walls into account anyway.

3.2.5 The statements of five persons experienced in the field of oil tanks, submitted by the Appellant (see Statement of Grounds of Appeal and its complement) show that there was a need to replace mechanical level measurement by microwave measurement. However, their statements do not start from the knowledge of D1 and thus cannot be of relevance for the judgment of inventive step over this document.

3.2.6 The Board therefore comes to the conclusion that the subject-matter of Claim 1 lacks an inventive step in the sense of Article 56 EPC.

3.2.7 The same is true for the apparatus according to Claim 3 since this claim contains essentially the same features as Claim 1.

4. Auxiliary request

4.1 Claim 1 according to the auxiliary request additionally specifies the feature that the microwave signal is fed to the tubular waveguide from the transmitter via a conical diameter adaptor having the form of a funnel hung down in the waveguide.

It is clear that a transition has to be made between the diameters of the transmitter and of the measuring waveguide. Such a transition between diameters is well known in the art of microwaves. As is shown in D10 and D11, a long taper (i.e. funnel) achieves transition with relatively little mode conversion. In order not to waste space, it appears to be obvious to hang it down in the waveguide.

For this reason, and since no synergistic effect with the other features according to Claim 1 can be recognised, the

said additional feature cannot contribute anything to the inventive step of the claimed subject-matter.

Thus, the subject-matter of Claim 1 according to the auxiliary request also lacks an inventive step.

4.2 The same is true for apparatus Claim 2 according to the auxiliary request which contains essentially the same features as Claim 1.

5. Claims 2 and 4 to 10 according to the main request and Claims 3 to 9 according to the auxiliary request are also not allowable because of their dependence on Claims 1 and 3 (main request) or Claim 2 (auxiliary request). The Appellant has not given any indication that he would be willing to restrict the scope of the independent claims any further than he has done by submitting the auxiliary request.

6. Since neither one of the two requests relates to patentable subject-matter in the sense of Article 52(1) EPC, grounds for opposition prejudice the maintenance of the patent (Article 102(1) EPC).

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini

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