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D E C I S I O N
of 10 February 2004

Case Number: T 0400/00 - 3.4.2

Application Number: 92910517.9

Publication Number: 0591239

IPC: G01B 7/06

Language of the proceedings: EN

Title of invention:

Film thickness measuring capacitive sensor

Patentee:

SUSSEX INSTRUMENTS PLC

Opponent:

Micro-Epsilon Messtechnik GmbH & Co. KG

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes - appeal dismissed)"

Decisions cited:

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Catchword:

-



Case Number: T 0400/00 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 10 February 2004

Appellant: Micro-Epsilon Messtechnik GmbH & Co. KG
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted 15 February 2000
rejecting the opposition filed against European
patent No. 0591239 pursuant to Article 102(2)
EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: M. A. Rayner
J. H. P. Willems

Summary of Facts and Submissions

- I. The present appeal is against the decision of the opposition division rejecting the opposition against European patent 591239 (application 92910517.9, International publication number WO92/20989) entitled film thickness measuring capacitive sensor.
- II. Amongst the documents presented during the proceedings, the following are relevant for the taking of the present decision:
- E2: DE-A-3 612 914
- E4: DE-A-3 435 908
- E5: DE-A-2 258 022
- E8: A brochure relating to the capaNCDT series 600 non-contact capacitive measuring system,
- E9: Operating manual for the same,
- E10: Correspondence between the firm Octagon and the appellant firm,
- E11: Test Report, and
- E12: Declarations by Messrs Wißpeinter and Salzberger.
- Documents E2, E4 and E5 were present in the proceedings before the opposition division, the remaining documents reached the file only at the appeal stage.

III. The independent claims of the patent as granted, upon which the decision of the opposition division was based are worded as follows:

"1. A capacitive sensor (1) for the non-contact measurement of the thickness of a film or sheet (12), the sensor (1) comprising:
a central electrode (2) and an outer electrode (3) surrounding the central electrode (2), the capacitance between the electrodes (2,3) depending on the presence of a film or sheet (12) in the capacitive fringe field of the electrodes (2,3);
gas outlet means (8,17) for providing, in use, a layer of pressurised gas (11) between the sensor (1) and the film or sheet (12) when gas is supplied to the outlet means (8,17); and
electronic means (6) for determining the thickness of the film or sheet (12) from a capacitance measured between the electrodes (2,3) when the film or sheet (12) is held away from the electrodes (2,3) by said layer of pressurised gas (11).

16. A method of capacitively measuring the thickness of a film or sheet (12) without contacting the film or sheet (12), the method comprises the steps of:
placing a capacitive sensor (1) adjacent one surface of the film or sheet (12), the sensor (1) having a face opposing the film or sheet (12) which includes a central electrode (2) and an outer electrode (3) surrounding the central electrode (2);
constantly passing pressurised gas between the film or sheet (12) and the electrodes (2,3) of the capacitive sensor (1) to keep the film or sheet (12) and the electrodes (2,3) a set distance apart; and

determining the thickness of the film or sheet (12) by detecting a change in capacitance in the fringe field between the electrodes (2,3) when the sensor (1) is placed adjacent the film or sheet (12)."

- IV. In its decision, the opposition division established that novelty was not contested by the opponent. The closest prior art document was taken to be document E2, disclosing an inductive sensor, whereas the patent makes use of a capacitance measurement. A mention of capacitive measurement in document E2 leads in context away from the invention. The division therefore concluded that the subject matter of claim 1, the corresponding method claim and the claims dependent therefrom comprised an inventive step over the prior art. The division also established that none of the other documents before it described a sensor or method for measuring the thickness of a film based on a capacitive fringe field measurement using a capacitive sensor having both electrodes of the capacitor concentrically arranged on the same side of the film the thickness of which is to be measured. For example document E4 discloses a magnetic or eddy sensor held in a predetermined distance controlled by an air cushion above the surface of a film, the thickness of which is measured based on distance to an underlying support. Document E5 describes a thickness measuring apparatus for measuring combined thickness of a metallic plate with a layer of an insulating material and thickness of the insulating layer alone. The sensor head is held at a predetermined distance from the upper surface of the insulating layer by its fluid pressure nozzle and a first inductive sensor thus moves responsive to thickness change. A second sensor provided in the

- sensor head, including a coil, measures the distance to the metallic substrate to determine thickness of the insulating layer.
- V. Both parties requested on an auxiliary basis oral proceedings, which were appointed by the board consequent thereto. The appellant filed documents E8 and E9 with the appeal. In the period between the summons and the oral proceedings, the appellant filed documents E10, E11 and the declarations, the respondent filing first to third auxiliary requests. In a communication annexed to the summons to oral proceedings, the board observed that one issue for discussion seemed to be what is to be understood from the reference to capacitive measurement in document E2. An opportunity would be offered for discussing the relevance of documents E8 and E9 with respect to non contact measurement of thickness. Both parties took advantage of this opportunity during the oral proceedings.
- VI. According to the appellant, document E2 reveals all the features of claim 1 of the patent in dispute relating to a floating sensor, except that the sensor disclosed operates inductively and not capacitively. Contrary to the view of the opposition division, the reference in document E2 gives the skilled person the idea of using the thickness and material dependent dielectric constant so far as relevant in capacitive sensing. The concrete form of the capacitive sensor pertaining to both electrodes being on one side was part of the knowledge of the skilled person. Reference is made to figures of document E8 and section 5.2 of document E9 simply to document the knowledge of the skilled person

as to this sensor, there being shown a middle electrode (Messelektrode) and an outer electrode (Masse), where field lines for a capacitive fringe field are shown (see especially the lower right figure on page 2 of brochure E8).

Documents E8 to E11 illustrate what was part and parcel of the knowledge of the skilled person and can also be taken as a starting point illustrating lack of inventive step. It had not been possible to provide this information at an earlier stage simply because of difficulties arising from the changes in archiving practice at the appellant company and difficulties associated with the alternative of providing it from customers. Considering claim 1, its subject matter involves two feature groups, (a) capacitive thickness measurement and (b) floating sensor features. The skilled person understands that documents E8 and E9 do not relate only to distance measurement, as suitability for thickness measurement with constant separation is recognised from the right hand picture on page 2 of document E8. Page 6 of the document E9 teaches avoidance of sensor contamination and contact with the object being measured, the problem being loss of sensitivity consequent to damage resulting from such contact. Page 11 mentions insulator form and thickness, which means that these can be taken to be variables to be determined. This is reinforced by the methods taught according to documents E10 and E11. Thus capacitive determination of thickness distance was available in the state of the art as also confirmed in this sense by the declarations E12. The state of the art also recognised the problem of contact damage had to be addressed, which the skilled person only had to take up

in an obvious way by maintaining constant separation with an air cushion. It can even be said without any reference to documents E8 to E12 that the knowledge of the person skilled in the art included floating sensors, the type of sensor not being significant.

A smoothly coated sensor surface is subject to wearing out by use in contact with a film. The skilled person knew of the danger of tearing the film from the passages of document E9 referred to above and also from documents E4 and E5 and thus that sensor contact therewith had to be avoided. Test (b) in document E11 thus did not correspond to the logic of the brochure E8, the test report was simply publication material.

Thus either starting from the knowledge of the skilled person or document E2, no inventive step can be seen in the subject matter of the independent claims.

- VII. The respondent was of the view that the argument of the appellant relating to the capacitive sensing in document E2 is incorrect as the passage concerned teaches away from the invention. The respondent challenged publication of documents E8 and E9, which could have been submitted earlier and contained no receipt from a customer. Moreover, as the brochure E8 derived from the appellant, the respondent had no chance of tracking down recipients. In any case, in the respondent's view, documents E8 and E9 contain no reference to thickness measurement and the capacitive sensor disclosed is for measuring distance. Moreover, keeping the sensor head clean applies for all capacitive measurement, this is not only for avoiding damaging the sensor head. In context documents E8 and

E9 thus refer to distance measurement where no air cushion is necessary. Document E11 indicates in test (b) that good contact is required for thickness measurement. While it is not disputed that capacitive fringe field thickness measurement was known at the priority date of the patent, the use of an air cushion was not considered appropriate because of impairing reliability by not maintaining a constant distance. Its use by the respondent was therefore inventive.

VIII. The appellant requested that the decision under appeal be set aside and that the patent in dispute be revoked. The respondent requested as main request that the appeal be dismissed and that the patent be maintained, or alternatively, that the patent be maintained in amended form on the basis of one of the first to third auxiliary requests filed in advance of the oral proceedings. The wording of the independent claims according to the main request is given in section III above. The wording of the independent claims of the auxiliary requests is not given as this is not necessary for the present decision (see point 5 of the Reasons below).

IX. At the end of the oral proceedings, the board gave its decision.

Reasons for the Decision

1. The appeal complies with the provisions mentioned in Rule 65(1) EPC and is therefore admissible.

2. The case of the appellant involves reference to documents E8 to E12, which were first filed during the appeal proceedings. In assessing these documents, the procedural situation was influenced by both parties, despite differing views on their timeliness, being prepared to take a substantive position in relation their content. In these circumstances, the board reviews these documents as follows:

2.1 Document E8 is a brochure pertaining to a position measurement transducer (the term "capaNCDT" derives from the wording "capacitive non contact displacement transducer"). An electrical conductor and an insulator are shown as measurement object in the bottom right figure on the second page. The sensor itself is shown as generally cylindrical with a central measurement electrode surrounded by a shield electrode and earth. Field lines for the measurement with the conductor are shown generally from the central electrode straight to the conductor, whereas in the second case they are shown curved back through the insulator to the outer earth.

2.2 Instruction manual E9 mentions in section 2.6 on page 7 that the sensor face has to be kept clean to avoid damage and also that dielectric constant and object thickness play an important role in the case of insulators. According to section 4.1 of the manual on page 10, the measurement principle is based on impedance of an ideal plate capacitor being a constant times separation. Section 5.2 on page 11 explains that linearisation and calibration are necessary for an insulating object and, among other things, form and thickness of the insulator have an influence on the

- calibration as does dielectric constant of the object being measured.
- 2.3 Correspondence E10 contains a letter from the firm Octagon seeking provision of a capacitive thickness measuring device. The letter recites that measurement of plastics foil must take place on one side according to an attached sketch. This sketch shows a sensor in contact with the foil. The correspondence also includes a pro forma bill for a device from the appellant.
- 2.4 Document E11 is an investigation report describing two thickness measuring methods (a) and (b). In method (a), the foil is between a sensor and a metal plate. In method (b), no metal plate is necessary, but a problem with completely planar contact between the foil and the sensor surface is mentioned. This problem can be solved by an increased pressure in a plastic tube or by air suction in the sensor.
- 2.5 The declarations both concern the availability of documents E9-E11. They do not pertain to technical features of the devices concerned.
3. Pertinent content of prior published documents E2, E4 and E5 considered in the proceedings before the opposition division can be summarised as follows:
- 3.1 Document E2 concerns measuring thickness of paper or the like. An air jet (see 12 in Figure 1) floats above a surface (7 in Figure 1) according to air pressure released therefrom, a device (16 in Figure 1) being arranged to measure its distance. If paper comes between jet and surface then the jet floats over the

paper, its distance from the surface increasing correspondingly. According to one embodiment, the device is disposed on a part rigidly attached to an air jet, which part can be out of the paper path so the distance measurement to the underlying surface is not influenced by the dielectric constant of the paper and can be capacitive (see column 4, first paragraph). In another embodiment, no further part is necessary as the distance from the measuring device to the underlying surface is directly measured, but a capacitive measurement is less suitable. Since paper usually has few or no magnetic components, an inductive measurement is a good possibility (see column 4, second paragraph).

3.2 The appellant only touched on documents E4 and E5 during the oral proceedings in the context of an air cushion avoiding sensor damage. The board thus sees no need for analysis of their content going beyond that of the opposition division, with which it agrees (see section IV of the Summary of Facts and Submissions).

4. The sole substantive issue in dispute concerns inventive step. If document E2 is taken as starting point in assessment of inventive step, in view of the thickness measurement deriving from change in distance to an underlying surface, features pertaining to capacitive fringe field sensing are novel. The problem solved can thus quite generally be considered to be that of developing measurement of thickness.

4.1 The teaching of document E2 is towards use of an inductive sensor for sensing of an underlying surface to which the distance varies corresponding to thickness of any intervening sheet. On the way to this

configuration, capacitive sensors are mentioned, but in a way the board considers detrimental to their application because they are portrayed as having the handicap of being either outside the paper path or subject to influence by paper dielectric coefficient. The approach of the appellant that a valuable idea towards capacitance thickness measurement is suggested is not very convincing because it implies the skilled person would, not could, have focussed on the dielectric coefficient of the paper as a measurement parameter, despite this effectively being portrayed in document E2 as a factor corrupting the result. Even had this been ignored, not capacitive fringe field thickness measurement, but a distance measurement to an underlying surface would be involved. Thus, the board reached the conclusion it is not possible to reach the subject matter of the independent claims in an obvious way from document E2.

Since documents E8 and E9 are concerned with distance measurement, there is neither an air layer nor any measurement of thickness provided. In the case of insulators, dielectric constant and thickness, amongst other things, are taken into account according to document E9 to avoid influence on calibration of distance measurement. The reference to influencing, in the board's view also in a detrimental way, tallies in this sense with document E2. There is thus no more reason provided in documents E8 and E9 to take a jump in reasoning and conclude that parameters mentioned in this context are to be measured than there was in the arrangement of document E2. Thus even assuming these documents illustrate the knowledge of the skilled person, it is not obvious that in conjunction with

document E2 they would have removed inventive step from the subject matter of the independent claims.

- 4.2 The appellant offered another line of argument starting with the knowledge of the skilled person as illustrated by documents E8 and E9, read as one document, as closest prior art. Leaving aside the casual combination of the teachings, the board is not persuaded that reference in section 2.6 of document E9 to the desiderata of keeping the sensor face clean and avoiding damage to the head suggests that a layer of pressurised gas as in document E2 should be provided. This is because both are general desiderata for capacitive sensors and, documents E8 and E9 not being concerned with thickness measurement but with distance measurement, no such air layer is necessary. The case of the appellant was not improved by the reference to document E11, because unlike the less relevant test (a) utilising a different capacitor configuration with a backplate, in the case where thickness is measured without an underlying surface i.e. test (b), despite the cleanliness and damage avoidance desiderata, contact does indeed occur between the film of which thickness is measured and the sensor. Such contact also tallies with the sketch in document E10 deriving from the firm Octagon and showing contact between the sensor and film. In test (b) the problem of planar sensor contact is even addressed by increased film application pressure or a suction system towards the sensor. In view of these very explicit disclosures, the board was only able to understand the submission of the appellant that contact according to test (b) was not in accordance with the logic of document E8 to underline the difference between the distance measurement in the

latter and thickness measurement in the former. Thus, while cleanliness and avoiding damage are general desiderata, the provision of an air cushion for providing a fixed separation in differential distance measurement in documents E2 or in documents E4 and E5, none of which are concerned with these desiderata, cannot in the view of the board be taken to mean that damage and cleanliness must be provided by such a cushion in any thickness measurement as such is in direct contradiction to the explicit teaching of contact according to test (b) of document E11 as reinforced by document E10.

- 4.3 The appellant therefore failed to convince the board that the subject matter of either of independent claims 1 or 16 according to the main request lacked an inventive step even taking account of all the documents presented. The same conclusion applies to the remaining claims which include all the features of claim 1 or 16.
5. In the circumstances of the present case, the lack of any successful substantive challenge to the patent as granted meant that it was not necessary to consider further either the admissibility of documents E8 to E11 or the content of the claims according to the auxiliary requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

P. Martorana

A. G. Klein