

Veröffentlichung im Amtsblatt	Ja/Nein
Publication in the Official Journal	Yes/No
Publication au Journal Officiel	Oui/Non



Aktenzeichen / Case Number / N° du recours : T 221/87 - 3.4.1

Anmeldenummer / Filing No / N° de la demande : 83 902 028.6

Veröffentlichungs-Nr. / Publication No / N° de la publication : WO 83/04098

Bezeichnung der Erfindung: Forward Scattering Laser Particulate Sensor

Title of invention:

Titre de l'invention :

Klassifikation / Classification / Classement : G01N 21/49

ENTSCHEIDUNG / DECISION

vom / of / du 11 November 1988

Anmelder / Applicant / Demandeur : United Technologies Corporation

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPU / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : Inventive step (yes)

Leitsatz / Headnote / Sommaire



Case Number : T 221/87 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 11 November 1988

Appellant : United Technologies Corporation
Hartford, CT 06 101 (US)

Representative : Waxweiler, Jean
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Decision under appeal : Decision of Examining Division 061
of the European Patent Office
dated 3 February 1987 refusing
European patent application
No. 83 902 028.6 pursuant to
Article 97(1) EPC

Composition of the Board :

Chairman : J. Roscoe
Members : H. Reich
G. Paterson

Summary of Facts and Submissions

- I. European patent application No. 83 902 028.6 (publication number W083/04098) was refused by decision of the Examining Division.
- II. The reason given for the refusal was that the subject-matter of Claim 1, received 10.03.86, did not satisfy the requirements of Articles 52 and 56 EPC having regard to document:

US-A-3 713 743 (D1).

The Examining Division took the view that a skilled person would arrive at the subject-matter of Claim 1 by only slight constructional changes in the apparatus according to document D1, which come within the scope of the customary practice followed by persons skilled in the art.

- III. The Appellant lodged an appeal against the decision.
- IV. In the Grounds of Appeal, the Appellant requested that the contested decision be set aside and that a patent be granted on the basis of an amended set of claims filed with the Grounds of Appeal. In supporting Claim 1 of this request, the Appellant argued mainly that it would not be obvious in view of the cited prior art to provide an annular stop (20) in the path of the scattered rays, this feature not being comprised in the independent claim underlying the appealed decision.
- V. In response to a communication of the Board of Appeal, inviting the Appellant to further amend his main claim, in particular in order to make Claim 1 include all essential features of the invention as required by Article 84 EPC, the Appellant filed, on 14 September 1988, a request for

the grant of a patent on the basis of the following documents:

Description: Pages 1-3, 4A, 6 and 16 received 20.05.87;
Pages 4, 5, 7, 8 and 10 received 14.09.88; and
Pages 9 and 11-15, as originally filed.

Claims: 1-5, received 14.09.88.

Drawings: Page 1/3 as originally filed,
Pages 2/3 and 3/3, received 14.09.88.

VI. Independent Claim 1 reads as follows:

"1. A sensor for monitoring the level of particulates in a gas flow comprising:

a laser (12) positioned to direct a beam of light across said gas flow (10);

a first lens (18) for collecting light scattered along a certain axis from a sample volume (16) located within said gas flow (10);

a first photodetector (22) positioned to receive a light focused thereon by said first lens (18), for providing a first detector output signal proportional thereto;

a second photodetector (30) positioned to receive light energy from said laser (12) for providing a second detector output signal proportional thereto; and

a threshold detector (64, 70) responsive to the first detector output signal and the second detector output signal for providing an output signal indicating when

the particulate level in said sample volume exceeds a predetermined level, characterised in that:

said first lens (18) produces by means of scattered light an image of the beam cross section at the centre of said sample volume on said first photodetector (22) matching the radius (h) of the beam cross section to the detector radius (r),

an annular stop (20) is located within said beam of light between said first lens (18) and said second photodetector (30) and has a central aperture and an annular aperture surrounding said central aperture and being sized to define limits of said sample volume in the direction of said beam of light;

said second photodetector (30) is positioned between said first lens (18) and said first photodetector;

and a second lens (28) is positioned within said central aperture of said annular stop (20) for focusing said light energy from said laser (12) onto said second photodetector (30)."

Claims 2-5 are referred back to Claim 1.

Reasons for the Decision

1. The Appeal is admissible.
2. The subject-matter of the set of claims does not extend beyond the content of the application as originally filed. In particular, the subject-matter of Claim 1 contains in addition to that of original Claim 1 the following features: annular stop 20 (see Figures 1 and 2 and the original description page 9, lines 15-21; second lens 28

(see Figure 2 and page 7, lines 6-9); the property of the first lens to image the sample volume centre onto the first photodetector in an radius matching way (see 2h and 2r in Figure 2 in combination with equations 2 and 3 on page 12 of the original description) and location of the second photodetector between first lens 18 and first photodetector 22 (see Figures 1 and 2). Furthermore, light source 12 was specified to be a laser (page 6, line 25).

The description has been adapted to the present wording of Claim 1. On page 7, line 5 and on page 10, line 10, the word "filter" was amended to "annular stop". Due to the fact that the light which passes through the annular aperture of means 20 is disclosed to originate from elastic Mie-scattering (original description page 13, lines 28 and 29), the term "filter" for means 20 is considered to be an obvious error.

There is, therefore, no objection under Article 123(2) EPC to the current set of application documents.

3. Novelty

- 3.1 From document D1 there is known "a sensor for monitoring the level of particulates in a gas flow (see D1, abstract) comprising: a laser (24 in Figure 1 of D1, see column 3, line 55) positioned to direct a beam of light across said gas flow 34; a first lens 38 for collecting light scattered along a certain axis from a sample volume 44 located within said gas flow 34; a first photodetector 40 positioned to receive a light focussed thereon by said first lens 38 for providing a first detector output signal 48 proportional thereto; a second photodetector 36 positioned to receive light energy from said laser 24 for providing a second detector output signal 46 proportional thereto (for proportionality of signals see column 2, lines 44-65); and a threshold detector 50, 52 responsive to the first

detector output signal and the second detector output signal for providing an output signal indicating when the particulate level in said sample volume exceeds a predetermined level, column 8, lines 22-23".

The above mentioned features of the sensor known from document D1 correspond to the features of the precharacterising part of Claim 1. None of the features in the characterising part of Claim 1 is derivable from document D1. In particular, this known sensor has no annular stop, and no first lens (for scattered light) which images the beam cross section at the sample volume centre onto the first photodetector, and no second lens (for unscattered light) at all.

3.2 All the other sensors known from cited documents measure the particle density not via the scattered light intensity but via the intensity loss in the primary beam, i.e. via the transmission behaviour of the sample volume; see detector 16 in Figure 1 of US-A-1 969 626; detector 11 in Figure 1 in combination with column 1, paragraph 1 of US-A-3 850 529; detector 21 in the figure of US-A-3 743 430 in combination with column 4, lines 3-8 (whereas detector 22 measures the primary beam intensity via the light reflected from the sample window); detector 38 in the figure of EP-A-0 029 537 in combination with page 9, lines 9-11.

3.3 Thus, the subject-matter of Claim 1 is considered novel in the sense of Article 54 EPC.

4. Inventive step.

4.1 Starting from the nearest prior art as disclosed in document D1, the objective problem underlying the present invention as claimed in Claim 1 is to provide an alternative form of sensor which is suited to monitor a

pipe of a large diameter; see the original description, page 4, lines 19-23.

- 4.2 This problem is solved by the features in the characterising part of Claim 1.
- 4.3 The cited prior art, in the Board's view, does not incite a skilled person to image the centre of a sample via scattered rays by guiding them through an annular stop onto the scattered intensity detector.
 - 4.3.1 In the sensor known from document D1, neither from the description nor the beam directions, shown in the figures by dashed lines, can it be concluded that the beam cross section at the centre of the known sample volume is imaged onto the known scattered light detector 40. Furthermore, the central portion of known scattered light detector 40 is covered by a masking element 42, the size of which fixes the length of the monitored sample volume; see document D1, column 4, lines 20-33. In the Board's opinion it surpasses by far the customary practice of a skilled person to modify the sensor known from document D1 by replacing known masking element 42 by the claimed annular stop 20, placing in its centre the further claimed second lens 28 for focussing unscattered light onto known detector 36 and by locating known detector 40 with mask 42 removed in such a way that its total uncovered input surface is completely illuminated.
 - 4.3.2 The further cited prior art gives no teaching how to handle scattered light rays, monitoring a sample exclusively on the basis of the extent to which it transmits the primary beam; see also point 3.2 above.
- 4.4 Thus, the subject-matter of Claim 1 is considered to involve an inventive step in the sense of Article 56 EPC and Claim 1 is allowable under Article 52(1) EPC.

- 4.5 Therefore, Claims 2-5, depending on Claim 1, are also allowable.
5. As the only ground for refusal, lack of inventive step, is no longer valid, the decision under appeal must be set aside. The Board, however, notes that it agrees with decision of the Examining Division, since the claims before them did not include the features of the annular stop and the imaging of the beam cross section at the sample volume centre onto an unmasked first photodetector.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a European patent on the basis of the following documents:

Description: Pages 1-3, 4A, 6 and 16, received 20.05.87;
Pages 4, 5, 7, 8 and 10, received 14.09.88;
and
Pages 9 and 11-15, as originally filed.

Claims: 1-5, received 14.09.88.

Drawings: Page 1/3 as originally filed;
Pages 2/3 and 3/3, received 14.09.88.

The Registrar:

The Chairman:

F.Klein

J.Roscoe