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Datasheet for the decision of 13 November 2007

Case Number: T 0553/05 - 3.4.01

Application Number: 00914854.5

Publication Number: 1105831

IPC: G06K 9/00

Language of the proceedings: EN

Title of invention:
Apparatus for viewing and inspecting a surface area of an object

Applicant:
Material Technologies Corporation

Opponent:
-

Headword:
-

Relevant legal provisions:
-

Relevant legal provisions (EPC 1973):
EPC Art. 56
RPBA Art. 10b(1)

Keyword:
"Inventive step (no; main request and first auxiliary request)"
"Late-filed request (not admitted; second auxiliary request)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0553/05 - 3.4.01

D E C I S I O N
of the Technical Board of Appeal 3.4.01
of 13 November 2007

Appellant: Material Technologies Corporation
57 Maryanne Drive
Monroe, CT 06468 (US)

Representative: Heusch, Christian
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 21 December 2004 refusing European application No. 00914854.5 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: B. Schachenmann
Members: H. Wolfrum
F. Neumann

Summary of Facts and Submissions

I. European patent application 00 914 854.5 (publication No. WO-A-01/13323 corresponding to EP-A-1 105 831) was refused by a decision of the examining division dispatched on 21 December 2004, for the reason of lack of inventive step (Articles 52(1) and 56 EPC) of the subject-matter of the request then on file.

The examining division based its decision on prior art given by document
D1: US-A-4 930 872 and the skilled person's knowledge.

II. The applicant lodged an appeal against the decision and paid the prescribed fee on 21 February 2005. On 21 April 2005 a statement of grounds of appeal was filed. The appellant requested the grant of a patent on the basis of two sets of claims 1 to 16, according to a main request and an auxiliary request 1, respectively, the main request corresponding to the request on which the contested decision was based.

III. On 29 June 2007 the appellant was summoned to oral proceedings to take place on 13 November 2007.

In a communication dated 3 July 2007 the board gave a preliminary view as to various issues to be discussed, including the question of inventive step. In this respect, reference was made *inter alia* to document D1.

IV. In response, the appellant filed by letter of 12 October 2007 two further sets of claims 1 to 16 labelled "4th auxiliary request" and "5th auxiliary request".

V. Oral proceedings were held on 13 November 2007.

After discussion the appellant requested that the decision under appeal be set aside and a patent be granted on the basis of

claims 1 to 16 of 12 October 2007 (former 4th auxiliary request) according to a **main request**;
claims 1 to 16 of 12 October 2007 (former 5th auxiliary request) according to a **first auxiliary request**; or
claims 1 to 15, filed in the oral proceedings of 13 November 2007 according to a **second auxiliary request**.

VI. Claim 1 of the appellant's **main request** reads as follows:

"*1. An apparatus (10) for viewing the surface area of an object and viewing and inspecting the surface area for anomalies, flaws or imperfections, comprising:*
an elongated, hand-held probe (14; 60; 70; 80; 100), including:
a viewing window (20) defining a field of view (F), the viewing window being approximately rectangular defining a width (W) and a height (H);
an image-forming lens (22) within the probe (14; 60; 70; 80; 100) spaced from the viewing window (20), and defining an optical axis (A-A) extending through the viewing window (20);
a CCD array image detector (24) within the probe (14; 60; 70; 80; 100) on an opposite side of the image-forming lens (22) relative to the viewing window (20) for receiving through the image-forming lens (22) a viewed image of a surface area of an object and transmitting electrical signals indicative thereof;
wherein the image-forming lens (22) and the image

detector (24) define a primary object distance (d_0) between the image-forming lens (22) and a primary target plane (T) wherein image resolution is optimal, and a primary image distance (d_1) between the image-forming lens (22) and the image detector (24), and

at least one of a focal length (f) of the image-forming lens (22), the primary object distance (d_0), and the primary image distance (d_1), is selected to:

(i) form the primary target plane (T) at approximately the viewing window (20) to thereby generate a relatively high resolution image of a viewed surface area located at approximately the viewing window (20);

(ii) focus approximately the entire field of view (F) onto the CCD array image detector (24) such that the entire field of view (F) is transmitted to an image display (16); and

(iii) define a depth (d) of field of view (F) at least approximately equal to a height (H) of the field of view and, wherein the depth (d) and the height (H) of the field of view (F) define a viewing space (S) in front of the viewing window (20) and where a point object on an imaginary plane (D), when imaged by the image-receiving lens (22) produces a geometrical blur of width equal to three pixels on the CCD array image detector (24); and

four light sources (26) mounted within the probe (14; 60; 70; 80; 100) between the viewing window (20) and the image-receiving lens (22) for approximately uniformly illuminating said viewing space (S), the light sources (26) being spaced inwardly of the viewing window (20) at a distance (l) at least approximately equal to the height (H) of the viewing window (20); and

the image display (16) remotely mounted relative to the hand-held probe (14; 60; 70; 80; 100) and coupled to the CCD array image detector (24) for receiving the signals transmitted by the image detector (24) and generating an enlarged image of the viewed surface area on the display (16), such that the surface area located anywhere within the viewing space (S) can be viewed and inspected, whereby the focal length (l) of the image-forming lens (22) focuses the height (H) of the viewing window (20) to exactly fill the corresponding dimension (h) of the CCD array image detector (24)."

Claims 2 to 16 are dependent claims.

Claim 1 of the appellant's **first auxiliary request** differs from claim 1 of the main request by the addition of the following features:

(a) the apparatus is for viewing the surface area of a three dimensional object and viewing and manually inspecting the surface area of such an object;

(b) the probe includes a body having a rectangular cross-section;

(c) the CCD array image detector receives a de-magnified image of the surface area of the object;

(d) the CCD array image detector is approximately rectangular;

(e) the light sources are mounted within the body of the probe; and

(f) the light sources are positioned to direct illumination forward through said viewing window providing illumination of the entire viewing space (S).

Claims 2 to 16 are dependent claims.

Claim 1 of the **second auxiliary request** is based on claim 1 of the first auxiliary request, in which the object is specified to be a cable or wire and to which the features "*and wherein the elongated, hand-held probe comprises a main body (102) and a detachable nose-piece (A,B,C), and the viewing window (20) and the light sources (26) are in the nose-piece (A,B,C), and the image-forming lens (22) and the image detector (24) are in the main body (102)*" are added.

Claims 2 to 15 are dependent claims.

VII. In support of inventive step for the subject-matter of its requests, the appellant argued in essence that document D1 did not represent pertinent prior art because it concerned an instrument for medical examinations and thus related to a technical field which had nothing in common with the field of inspecting cables or wires in difficult environments, such as in aircraft, addressed by the present invention. Therefore any coincidences between the known instrument and the claimed apparatus were purely accidental and using D1 as a starting point for the problem-solution approach constituted an ex-post facto analysis. The actual state of the art available to an inspector of aircraft cabling at the priority date of the present application was a torch held in one hand and a further tool, such as a mirror, held in the other hand. Handwritten notes were required in order to keep track of anomalies detected. It was the achievement of the inventors to realize the disadvantages associated with the inspection devices of the prior art and to analyse the problems. Thus, to some extent the present invention could be considered a problem invention. Moreover, the inventors, instead of improving existing tools, devised a

completely novel device in the form of a simple, inexpensive and rugged apparatus allowing for a one-hand-free real-time inspection of three dimensional objects located in front of the apparatus.

But even if, for the sake of argument, document D1 were considered to constitute relevant prior art, it disclosed a device for microscopic examination of small skin anomalies and thus was not suitable for inspecting larger three-dimensional objects, such as the miles of aircraft cabling, for which the claimed apparatus was designed. In the absence of any hint in the available prior art as to the needs which have to be met by the different kind of use, the skilled person was not in a position to devise all the necessary modifications required for arriving at the claimed subject-matter. In fact, the claimed apparatus differed from the known medical device in various aspects. Whereas the known device had an optical system producing a magnified image on the image detector of a flat surface area from within a small, round field of view and a viewing space with an almost negligible depth of focus, the apparatus according to the invention had an optical arrangement which produced a sharp, de-magnified image of rectangular shape of a three-dimensional object located within the viewing space, the image truly filling the area of the image detector. This became possible only by devising an optical system that possesses a rectangular field of view and a significant depth of focus which is approximately equal to the height of the field of view. The resulting apparatus thus was truly operable in a single-handed manner, whereas the known device rather resembled a microscope which, due to its large optical magnification and shallow depth of focus, had to be pushed up against the surface to be

viewed. A further significant difference was to be seen in the arrangement of four light sources within the body at a position between the viewing window and the imaging lens. With the light sources being closer to the viewing window than in the device of document D1, reflections gathered by the lens were reduced and the viewing space was more homogeneously illuminated so as not to miss any imperfection at the object under inspection.

Finally, a number of secondary indicia further supported the presence of an inventive step. Notwithstanding a long-felt need for improving inspection of three-dimensional objects in locations difficult to access nobody had come up with the claimed solution. The invention had led to a product which in fact turned out to be a big commercial success. Moreover, the present invention provided a procreative basis for the development of quite a number of new products.

The late filing of a further request in the oral proceedings, *ie* the second auxiliary request, was justified by the circumstance that it was only then that the appellant became aware of the fact that the board was inclined to consider document D1 a relevant state of the art. Moreover, the amendments made should be admitted into the proceedings since they were based on an existing dependent claim, and did not produce any surprising new aspects. The amendments were supported by claim 19 as originally filed, Figure 9 and information provided on page 3, line 24, page 12, lines 15 to 28, and page 13, lines 1 to 18, of the application description as published.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. **Main request**

Inventive step (Articles 52(1) and 56 EPC)

2.1 Document D1

The document refers to an imaging system or apparatus for the detailed dimensional analysis of surface features and more specifically for producing a magnified electronic image of a surface region of an object in a reliably repeatable manner (cf column 1, lines 7 to 10; column 2, lines 5 to 8; Figure 1 and the corresponding description in columns 3 to 5). The known viewing apparatus is constructed of a size to be hand held (column 2, lines 25 to 28; column 3, lines 40 to 43). It includes as basic elements an elongated hand-held probe having a body with a distal circular viewing window (Figure 2; column 4, lines 57 to 60), and, arranged within the body, a light source for uniformly illuminating the viewing window (column 2, lines 14 to 21), an image-forming lens system (column 2, lines 16 to 18; column 4, lines 19 to 23), and a CCD array image detector on an opposite side of the image-forming lens relative to the viewing window (column 4, lines 41 to 46; column 7, lines 45 to 47). Moreover, the apparatus comprises an image display coupled to the image detector and remotely mounted relative to the hand-held probe for receiving the signals transmitted by the image detector and generating an enlarged image of the viewed surface area on the display

(column 4, lines 44 to 50; column 7, lines 1 to 3 and 29 to 41).

More specifically, as regards the optical arrangement of the known viewing apparatus, the image-forming lens system is spaced from the viewing window and aligned so as to define an optical axis extending through the viewing window, a primary object distance (d_0) between the lens system and a primary target plane where image resolution is optimal, and a primary image distance (d_i) between the lens system and the image detector (column 4, line 67 to column 5, line 2; column 5, lines 6 to 10 and 17 to 22; column 6, lines 2 to 5). The viewing window, although being shaped as a circular frame (Figure 2), nevertheless encircles the field of view (FOV) of the optical arrangement (column 5, lines 55 to 59). The focal length, the primary object distance (d_0) and the primary image distance (d_i) are in fact selected to form the primary target plane at the viewing window to thereby generate an image of optimum resolution of the viewed surface area located at the viewing window (column 4, lines 57 to 60; column 4, line 67 to column 5, line 2). Moreover, in combination with a properly set aperture within the lens system, a depth of focus (DOF) is achieved which corresponds to the depth of the surface feature to be inspected and limits in longitudinal extension a viewing space which is laterally limited by the FOV (abstract; column 6, lines 25 to 29).

In order to uniformly illuminate said viewing space, the light source is advantageously formed by a ring light which is mounted within the probe in front of the centre of the lens system in the direction towards the viewing

window (Figures 1 and 4; column 3, lines 53 to 55; column 4, lines 13 to 15 and 60 to 63).

2.2 The appellant argued that document D1 did not constitute relevant prior art and should not be used as a valid starting point for a problem-solution analysis of inventive step because it referred to the field of devices for medical diagnosis and thus to a technical field which an expert in the field of the present invention, in particular that of inspecting of cables and wires in aircraft or other industrial areas which are difficult to access, could not to be expected to be familiar with.

Although the sole specific embodiment of the viewing apparatus described in document D1 is indeed a medical inspection device to be used for instance by a dermatologist in order to inspect nevi on the surface of a person's skin and to make historical records thereof (column 3, lines 26 to 29), the board cannot accept the appellant's assertion that document D1 could therefore have been retrieved and cited only with the benefit of hindsight.

First of all, there is nothing in the claims of the main request which would in any way limit the claimed invention to a particular field of use. Hence, any argument attempting to restrict the technical field at issue to that of a particular profession must fail. Moreover, the teaching of document D1 is by no means limited to the field of devices for medical diagnosis but refers to optical apparatuses for viewing and imaging surface regions of objects in general (cf claim 1). In fact, the document expressly mentions other possible

fields of use where repeatable images of surface features would be helpful and cites quality control of industrial finishing as a specific example (column 1, lines 57 to 60).

For these reasons, document D1 is to be regarded as relevant prior art for the assessment of inventive step.

2.3 As is apparent from the explanations given in paragraph 2.1 above, the hand-held viewing apparatus known from document D1 has the same basic elements arranged in fundamentally the same configuration as the apparatus according to claim 1 under consideration.

The subject-matter of claim 1 of the main request differs from the known apparatus by the following features:

(i) the viewing window is rectangular;

(ii) the DOF (coined "*depth of field of view*" in the claim) is at least approximately equal to a height of the field of view;

(iii) the DOF is such that a point object on an imaginary plane, when imaged by the image-receiving lens produces a geometrical blur of width equal to three pixels on the CCD array image detector; and

(iv) the number of light sources is four.

2.4 Contrary to the appellant's submissions, no differences can be seen in the features that:

- the apparatus according to the invention is a truly hand-held device;
- the rectangular viewing window defines a FOV,
- the entire FOV is focussed onto the CCD array image detector so that the height of the viewing window is

focussed to exactly fill the corresponding dimension of the image detector;

- the apparatus allows for inspection of larger three-dimensional objects due to the fact that the image-forming lens produces a de-magnified image; and
- the light sources are mounted between the viewing window and the image-forming lens and spaced inwardly of the viewing window at a distance at least approximately equal to the height of the viewing window.

Notwithstanding the fact that according to the description of the specific embodiment of the known viewing apparatus the probe is indeed intended to be pushed up against the surface to be viewed, there is no doubt that the probe nevertheless remains hand-held in such a position. Thus, the claimed property "hand-held" cannot define any concrete distinction to the known apparatus. Besides, also the description of the present application envisages a use of the apparatus in which the probe would be pushed up against anything an inspector would normally touch (page 1, lines 23 to 25; page 7, lines 23 to 24; page 9, lines 18 to 19, of the published application).

The FOV, by convention, refers to the "angle of view" of a lens (system) within which the lens provides an image of an object on a given detector surface. Any part of the object outside the FOV will not be imaged onto the detector surface. The FOV is thus established by the format of the image detector, the focal length of the lens system and the primary image distance d_i, but is not related to the size and format of the viewing window at the distal end of the probe's body. Since, as a rule, commercially available CCD array image detectors possess

a rectangular format, it has to be presumed that the FOV in the viewing apparatus known from document D1 is rectangular as well. Moreover, provided the viewing window does not obstruct the FOV (for which care is taken in the optical arrangement of the apparatus shown by document D1: see column 5, lines 55 to 59) it is inherent to the concept of the FOV, when applied in its conventional technical meaning, that it is the entire FOV which is focussed onto the CCD array image detector (and ultimately transmitted to the image display) so that it exactly fills the corresponding dimensions of the detector.

Moreover, there is no requirement in the claim under consideration for the image-forming lens to produce a de-magnified image of an object filling the viewing window.

Finally, as regards the arrangement of the light sources, Figures 1 and 4 of document D1 show the ring light mounted close to the image-forming lens system with the light emitting surface of the ring light being shifted away from the centre of the lens system towards the viewing window. This arrangement thus fulfils the condition of claim 1 that the light source(s) are mounted between the viewing window and the image-receiving lens. Moreover, since the light source is farther away from the viewing window than the height of the viewing window the vague condition "*at a distance at least approximately equal to the height of the viewing window*" is met as well. This condition is considered to be met because it can be interpreted to mean "at a distance which is greater than the approximate height of the viewing window".

2.5 For the reasons just given in paragraph 2.4, aforementioned difference (i) is a mere matter of design of the probe's body. Insofar as it is of technical relevance, it indicates that the viewing window is shaped to frame the FOV. The circular viewing window provided in the viewing apparatus known from document D1, although not exactly conforming to the rectangular FOV, nevertheless performs the same function and thus constitutes a technically equivalent measure.

As regards differences (ii) and (iii), document D1 expressly instructs the skilled reader that the DOF should correspond to the depth of the surface feature to be inspected and can be set by providing a proper aperture within the image-forming lens system. In the Board's opinion, document D1 thus provides sufficient information so as to enable the skilled person, who, in the technical field at issue, possesses the qualification of a physicist or engineer acquainted with optical imaging apparatuses, to correspondingly adapt the DOF of the known apparatus to the demands posed by the task of viewing objects which happen to have a longitudinal extension of surface structures in the order of the height of the viewing window, as is specified by feature (ii). Besides, the fact that sharp images of three-dimensional objects necessitate a large DOF and the measures which have to be taken in order to increase the DOF belong to the basic knowledge of even an amateur photographer.

A fundamental consideration when setting the desired DOF is inevitably the choice of an acceptable level of blur according to feature (iii). The choice of an acceptable blur of specifically three pixels on the image detector thus does not constitute an element of a solution to a

technical problem but is rather a definition of, or condition for, the accepted limit of resolution associated with the imaging task.

Finally, as regards the provision of exactly four light sources according to difference (iv), this measure serves to provide an approximately uniform illumination of the viewing window (cf page 6, lines 10 to 12 of the published application description). However, in this respect no additional technical effect is achieved which would not be obtained with the ring light of the known viewing apparatus so that no technical problem can be attributed to difference (iv), already known from the prior art.

2.6 It follows from the above considerations that, as far as the claimed subject-matter differs from the viewing apparatus known from document D1, the claimed measures either constitute merely technically equivalent variations to the known structural elements or come within the scope of straightforward modifications of the optical setup to a different viewing task.

Therefore, claim 1 of the main request does not involve an inventive step within the meaning of Article 56 EPC.

Consequently, the main request is not allowable.

3. **First auxiliary request**

3.1 Claim 1 of the first auxiliary request differs from claim 1 of the main request by features (a) to (f) listed in paragraph VI. above.

3.2 Contrary to the opinion expressed by the appellant, feature (a) does not define a tangible difference to the known viewing apparatus. In both cases a hand-held probe is operated by a user viewing and inspecting a surface area. Moreover, Figure 3 of document D1 illustrates an example of a three-dimensional structure of the viewed surface area.

As regards feature (b), no technical effect is apparent which would be associated with a body of rectangular cross-section in distinction to a circular cross-section of the body of the known apparatus.

With respect to feature (c), the board considers the aforementioned skilled person to be aware of fundamental laws of geometrical optics, such as the lens formula. Thus, the skilled person, when facing a task that renders desirable the inspection of objects or surface areas the dimensions of which exceed the size of the CCD image detector, would know that by simply shifting the lens position relative to the viewing window and the image detector, ie by properly adapting the parameters d_0 and d_i, the optical set-up can be modified so as to generate a de-magnified image at the detector of an object at the viewing window. The order of magnification - or demagnification - of the image is simply a question of use-dictated design specifications. According to the intended use of the apparatus, the appropriate magnification would be immediately apparent.

As already indicated in paragraph 2.4 above, commercially available CCD array image detectors generally come in a rectangular format so that feature (d) cannot distinguish the claimed subject-matter from the prior art apparatus.

For the same reason as given in paragraph 2.1 above, features (e) and (f) are also present in the viewing apparatus known from document D1.

3.3 It follows that also the subject-matter of claim 1 of the first auxiliary request does not involve an inventive step within the meaning of Article 56 EPC.

Therefore, the first auxiliary request is not allowable either.

4. **Second auxiliary request** - admissibility

4.1 Article 10b(1) RPBA states that "any amendment to a party's case after it has filed its grounds of appeal or reply may be admitted and considered at the Board's discretion. The discretion shall be exercised in view of inter alia the complexity of the new subject-matter submitted, the current state of the proceedings and the need for procedural economy."

4.2 As regards the present main request and the first auxiliary request, which were both filed one month before the oral proceedings, the board exercised its discretion in favour of the appellant and admitted the requests into the proceedings for discussion at the oral proceedings. It was decisive for the board in this case that the amendments were merely aimed at removing an objection under Article 123(2) EPC raised by the board in its communication of 3 July 2007 and that, consequently, the requests replaced the previous main request and first auxiliary request. Moreover, the board had been given sufficient time for studying the amendments.

As regards the second auxiliary request, the situation is different. The request was filed only at an advanced stage of the oral proceedings after a discussion of the inventive merits of the main request and first auxiliary request had already taken place. Moreover, the amendments raised prima facie new problems under Article 123(2) EPC, for which the board did not see a quick and straightforward solution. In fact, one of the amendments made to claim 1 of the second auxiliary request concerned the introduction of the features of a nose-piece being detachable from a main body and a specific distribution of the light source, lens and detector over the two parts of the body. The added features were derived from claim 19 as originally filed, which, being dependent only on claim 1 in its original version, does not comprise the feature combinations encompassed by the wording of claim 1 of the present second auxiliary request. In the absence of corresponding support in the application description and figures, the board did not find a basis of disclosure of, for instance, an apparatus combining a detachable nose-piece with exactly four light sources or with an optical set-up providing a de-magnified image at the image detector, as claimed by claim 1 of the second auxiliary request. In this context, the appellant argued that the relevant description of Figure 9, which showed the embodiments of detachable nose-pieces, disclosed the claimed feature combination in that it referred to the probe as being "similar" to the probe of Figure 2 through 5, which embodiment in turn had four light sources and showed a de-magnified image on the image detector. However, this argument could not convince the board because the degree of intended similarity could not be established from the term "similar". Thus it was not

clear exactly which features of the embodiment of Figures 2 to 5 were intended to be preserved in the embodiment with the detachable nose-piece.

Order

For these reasons it is decided that :

1. The second auxiliary request is not admitted into the proceedings.

2. The appeal is dismissed.

The Registrar The Chairman

R. Schumacher B. Schachenmann