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Case Number: T 1905/09 - 3.4.02

Application Number: 03732738.4

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Title of invention:
IMAGING APPARATUS

Applicant:
QinetiQ Limited

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:

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Case Number: T 1905/09 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 5 October 2012

Appellant: (Applicant)	QinetiQ Limited Cody Technology Park Ively Road Farnborough Hampshire GU14 0LX (GB)
Representative:	Day, Caroline Margaret QinetiQ Limited Intellectual Property Malvern Technology Centre St Andrews Road Malvern, Worcestershire WR14 3PS (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted 2 April 2009 refusing European patent application No. 03732738.4 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: F. Maaswinkel
D. Rogers

Summary of Facts and Submissions

I. The appellant lodged an appeal against the decision of the examining division, refusing the European patent application 0372738.2 (international publication number WO 2004/005870 A1). This patent application relates to an imaging Fourier transform spectrometer.

II. In the decision the following documents were cited:

D2: US-A-5 781 293
D3: WO-A-99/06807
D5: US-A-4 320 973.

In the decision under appeal the examining division found that the subject-matter of claim 1 lacked an inventive step having regard to the disclosure in document D3 (Art. 52(1) and 56 EPC). In particular the claimed apparatus differed from the imaging Fourier transform spectrometer of D3 only in that it included a second Wollaston prism rigidly mounted against movement. It was known in the art that a spectrometer comprising only a single Wollaston prism suffered from the problem that in such a prism the effective splitting points for the rays lie in a plane inclined to the exit face of the prism, thus resulting in a tilted image/detector plane, see document D2, col. 3, l. 64 – 67; and D5, col. 3, l. 3 – 6. In both documents it was disclosed that by adding a second Wollaston prism the effective splitting plane could be arranged perpendicular to the optical axis. Therefore, by following the teaching of document D2, the skilled person would add a second Wollaston prism to the system shown in Figure 1 of document D3, thereby arriving at

the subject-matter of claim 1 without any inventive skill.

III. The appellant requested that the decision be set aside and a patent be granted on the basis of the set of claims submitted under cover of a letter dated 2 February 2009.

IV. The documents comprising the appellant's request include:

Claims:	1 to 9, submitted under cover of a letter dated 2 February 2009;
Description:	pages 1, 5 to 10 as published; pages 3a, 4, 11, 12 filed with telefax on 12 December 2007; pages 2, 3 submitted under cover of a letter dated 2 February 2009;
Drawings:	sheets 1/4 to 4/4 as published.

V. The wording of independent claim 1 reads as follows:

"An imaging apparatus comprising on an axis:-
(i) an input polariser (20) for resolving light incident thereon into a single linear polarisation state,
(ii) a first polarising beam splitter (22; 32; 38) arranged to receive light passing through the input polariser, and arranged to resolve said light into equal magnitude orthogonally polarised rays, said rays being mutually spaced and having a path difference therebetween,
(iii) at least one additional polarising beam splitter (24; 34; 36; 40) arranged to receive light passing through the first polarising beam splitter,
(iv) an output polariser (28),

(v) focussing means (26),
the first polarising beam splitter, the or each additional beam splitter and the focussing means being mutually spaced such that said mutually spaced rays are brought to coincidence whereby interference fringes are produced, and
(vi) a light sensitive detector (30) arranged to detect said interference fringes,
characterised in that the orientation of the transmission axis of the output polariser is parallel to or perpendicular to the transmission axis of the input polariser such that the output polariser is arranged to resolve the orthogonally polarised light rays having passed through the or each additional polarising beam splitter into the same polarisation state as light resolved by the first polariser, or a polarisation state perpendicular thereto; in that one beamsplitter is mounted for movement perpendicular to said axis, the other beam splitter(s) being rigidly mounted against movement; and in that the first polarising beam splitter and the or each additional polarising beam splitter are Wollaston prisms ".

Claims 2 to 8 are dependent claims.

The wording of independent claim 9 reads as follows:

" Use of the apparatus of any preceding claim for generating a temporal interferogram ".

VI. The appellant's arguments may be summarised as follows:

The decision presents document D3 as the most relevant prior art: this document is directed to the provision of an imaging Fourier transform spectrometer which is

not excessively sensitive to component alignment and which uses light with high efficiency. As is clearly apparent from document D3 as a whole, a progressive development is shown from a simple embodiment in Figure 1 in which a birefringent element is displaced transversely to the axis of the instrument, to a further embodiment in Figure 4 which uses a beamsplitter and a birefringent element in each of two light paths which later combine with reinforcement to use a very high proportion of the light. Document D3 teaches (p. 10, l. 19 to p. 12, l. 2) that while a Wollaston prism is a preferred choice of birefringent element, other types of birefringent element could be considered as alternatives if particular device properties were required. While it is not clear that the fringe arrangement in the Figure 4 embodiment of D3 causes any difficulty (it is noted at p. 18, l. 12 to 13, that the fringes are formed parallel to the edges of beamsplitter 24), it is possible that the person skilled in the art may wish to bring all optical paths parallel to the optical axis. If so, the teaching of document D2 could be considered, and the skilled person may then choose as a birefringent element a pair of equal and opposite Wollaston prisms fixed with respect to each other, as indicated at D2, col. 4, l. 6 to 11. The skilled person would choose as a spectrometer design that of Figure 4 of document D3 with the single Wollaston prisms of this document each replaced with a matched and mutually fixed Wollaston prism pair of document D2. Nothing would motivate the person skilled in the art to modify the Figure 1 embodiment of document D3, as D3 clearly teaches this to be a stepping stone toward the preferred embodiment of Figure 4. It should be noted, however, that if the same modification were made to the Figure 1 embodiment, the claimed invention would not result, as the opposed

Wollaston prisms would be fixed relative to each other, and only translatable as a pair. Nothing in D2 or D3 suggests any alternative possibility.

In contrast, the arrangement defined in claim 1 has the benefit of simplicity and effective optical gearing. As all translation occurs between the Wollaston prism pair, this can be effectively designed as a subassembly to minimise problems of alignment and relative movement. It is therefore submitted that claim 1 involves an inventive step over document D3 as a starting point on a properly constructed problem-and-solution analysis.

In the decision reference was also made to earlier communications of the examining division, in which, by starting from document D2 and combining its teaching with the disclosure in document D3, inventive step had been denied. Document D2 provides a Fourier transform spectrometer with no moving parts by use of two Wollaston prisms and an extended light source. As it is a central objective of D2 to produce a spectrometer which has no moving parts, it is difficult to see how the skilled person would be motivated to produce a solution of the form of the present invention, in which one Wollaston prism is translated relative to the other. D2 is reliant on the use of a highly uniform extended light source. An objective technical problem associated with D2 is the desirability of replacing this component with one that is easier to manufacture. This would admittedly result in the sacrifice of a key feature of D2, that there are no moving parts in the spectrometer - D2 functions as an imaging spectrometer with no moving parts only because of the use of an extended light source. With this extended light source, a spectrum of different path differences is available

for light incident upon the Wollaston prism pair in all possible directions of incidence. If the extended light source is to be replaced, the skilled person would appreciate that as in D3, translation of the birefringent component transversely to the optical axis of the spectrometer would enable this spectrum of path differences to be sampled. However, in the D2 embodiment, the birefringent component is the matched pair of Wollaston Prisms 32, 34 as shown in Figure 6. To solve the objective technical problem of prism matching, the person skilled in the art would seek to translate the prism pair as one unit transversely to the optical axis of the spectrometer, and by doing so would exactly reconstruct the spectrum of path differences sampled in the Figure 6 embodiment of D2. This construction would not anticipate claim 1.

The appellant was not able to determine any more appropriate objective technical problem with D2 as starting point than that of prism matching given above. The invention as claimed has the advantages that it provides highly effective optical gearing and readily controllable movement as the optical components only need to be translated relative to each other. The appellant considered that the invention as claimed would not be obvious over D2.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

In the decision no objections under Art. 84 and 123(2) EPC had been raised. The board does not have any such objections of its own.

3. *Patentability*

3.1 *Novelty - Claim 1*

3.1.1 In the decision the examining division considered document D3, in particular the apparatus shown in Figure 1, as the closest prior art.

3.1.2 In the grounds of appeal the appellant doubted that, having regard to the disclosure of document D3 in its entirety, the skilled person would have been motivated to consider the apparatus shown in Figure 1 as a starting point for improvement, because D3 clearly discloses the embodiment in Figure 4 as the preferred embodiment.

3.1.3 The board concurs with the appellant that the embodiments shown in Figure 2 of D3 (*"improvement in transmission efficiency", see p. 8, l. 13 and 14*), Figure 3 (*"…the optical efficiency can be increased to nearly 100%", p.8, l. 18 and 19*) and Figure 4 (*"…to allow for a more convenient mechanical arrangement", p. 8, l. 21 and 22*) are presented as more advantageous as the one in Figure 1 (*"simple embodiment", p. 8, l. 10*). However, the "simplest embodiment" (*p. 12, l. 9 - p. 13, l. 20*) in Figure 1 is an "embodiment" in the sense that it solves at least the partial problem of prior art Michelson interferometers which are sensitive to very small displacements of the optical elements (*p. 3, l. 2 and 3*) and that its construction is defined in independent claim 1 of document D3. The skilled person would, if faced with the problem to construct an

alternative Fourier transform spectrometer to the classical Michelson interferometer, but without its disadvantages, select in document D3 the embodiment according to his particular need and resources. The embodiment in Figure 4 (*or Figures 2 or 3*) is optically more efficient, however this includes further (*high-precision and expensive*) optical components (*polarising beamsplitter(s), retarding plates*). Therefore, if in the concrete situation optical efficiency is of less importance than simplicity of the device, the skilled person would opt for the embodiment in Figure 1. Hence, for the analysis of the patentability of the subject-matter of claim 1 the embodiment in Figure 1 of document D3 may be considered as a proper example of the closest prior art.

3.1.4 The arrangement shown in Figure 1 of document D3 discloses an imaging apparatus with the following features from claim 1:
(i) an input polariser (linear polarising filter 3);
(ii) a first polarising beamsplitter (Wollaston prism 5), mounted for movement perpendicular to the optical axis (p. 13, l. 18);
(iv) an output polariser (analyser 6), wherein the orientation of the transmission axis of the output polariser is parallel to that of the input polariser;
(v) a focusing lens (relaying lens 8); and
(vi) a detector (photosensitive target 7).

3.1.5 The arrangement defined in claim 1 differs from the apparatus in Figure 1 of D3 by the feature that it comprises at least one additional polarising beam splitter, which is a Wollaston prism, and which is rigidly mounted against movement. Therefore the subject-matter of claim 1 is novel. This had not been contested in the decision under appeal.

3.2 *Inventive step*

3.2.1 With respect to the technical problem addressed by the arrangement defined in claim 1, the examining division considered that the skilled person, designing a Fourier spectrometer with a birefringent device according to the teaching of D3, would obviously envisage to optimise that device, "the starting point being a single Wollaston prism".

The examining division further considered, "It is known in the art that "for a single Wollaston prism, the effective splitting points for the rays corresponding to the two polarisations lie in a plane inclined to the exit face of prism"…". In this respect reference was made to documents D2 (col. 3, l. 64 - 67) and D5 (col. 3, l. 3 - 6), the examining division noting that the latter document had "…been filed for a long time (1975)".

3.2.2 The board has some reservation against this position: a definition of the technical problem over the disclosure in Figure 1 of document D3 as "optimising that device" appears to be correct, since the aim of optimising a prior art device is inherent to each later patent application. However, the phrase "…the starting point being a single Wollaston prism" appears to introduce a pointer to the technical solution, since the skilled person would, when studying the arrangement in Figure 1 of D3, not have any indication why an improvement should be based on modifying the single Wollaston prism: indeed, all subsequent embodiments in D3 (*Figures 2 - 4*) rely on one Wollaston prism per ray path (*the arrangements in Figures 3 and 4 include two ray paths 21 and 26, each comprising one Wollaston*

prism), therefore the skilled person would not have any reason to consider modifying this optical element.

3.2.3 It is also noted that, although the arrangement in Figure 1 of document D3 is "complete" in the sense that it contains the complete optical path, starting at the object plane 1 until and including the photosensitive target (CCD 7), this document does not touch upon a possible problem of an inclined plane of the interference fringes, therefore the skilled person understands that the arrangement in Figure 1 is technically feasible.

3.2.4 In its reasoning the examining division referred to patent publications D2 and D5 (*of which D5 had been published in 1982*) to show that the inclination of splitting points in a Wollaston prism is "known in the art". This formulation suggests that this phenomenon is established knowledge in the technical field. This may or may not be the case, but the only references cited in the decision under appeal are patent documents. As explained in the Guidelines for Examination, Part G, Chapter VII-6, point (iii) (July 2012), the "common general knowledge" in the art should normally be documented in well-known textbooks, for instance an optics textbook, rather than being disclosed in patent publications, whose contents relate to more specialised subject-matter rather than common general knowledge. That patent documents cannot be regarded as a disclosure of such common general knowledge is illustrated in the present case by the fact that document D5 had been published 15 years before the priority date of document D3, and yet had apparently not been considered by the inventors of D3 for identifying or addressing a problem with an inclined fringe plane.

3.2.5 Therefore the board doubts that the skilled person, addressing the technical problem of improving the arrangement in Figure 1 of document D3 other than by progressing to the technically more favourable arrangements in Figures 2 - 4 of this document, would have had any obvious reason to consider to combine the teaching of document D2 with the one of D3.

3.2.6 For the sake of argument it is added that, as correctly pointed out by the appellant, document D2 addresses rather different Fourier transform spectrometers than the arrangement in Figure 1 of document D3 in that these have no moving parts and rely on an extended light source, see the Abstract of D2. A correction of the effect of the inclined plane is discussed in the context of Figure 6 of document D2, disclosing (col. 4, l. 6 - 13) "…replacing the single Wollaston prism with a matched prism pair 32, 34". Therefore the only measure the skilled person would learn from this document D2 is that the single prism (*in the particular case: Wollaston prism 5 in the arrangement in Figure 1 of D3*) could be replaced by a matched prism pair as shown in Figure 6. Since the particular embodiment of Figure 6 of D2 does not have any moving parts and the prisms are a "matched pair with their internal angles arranged in opposite senses" (col. 4, l. 8 and 9), i.e. are in a mutually fixed arrangement, the translatable single Wollaston prism in Figure 1 of document D3 might be replaced by the matched prism pair 32, 34, which would be translatable as one "double Wollaston prism" (D2, col. 4, l. 9).

3.2.7 Neither document D2, nor document D5 discloses or suggests to combine a translatable Wollaston prism with a second, fixedly mounted Wollaston prism.

Therefore, combining the disclosure in document D3, Figure 1, with the teachings of document D2 (*or D5*) would not result in the subject-matter of claim 1.

3.2.8 In an "Obiter Dictum" remark added to the decision the examining division referred to its earlier communications, in which it had based its reasoning for lack of inventive step on the embodiment in Figure 6 of document D2. This arrangement comprises the matched pair of Wollaston prisms 32 and 34 and does not have any moving parts, which, in this embodiment, because of the use of an extended light source (*Figure 6: "Extended Input"*) are not necessary, see col. 3, l. 19 - 25.

3.2.9 Starting from this embodiment as the closest prior art and noting that the subject-matter of claim 1 essentially differs from the arrangement in Figure 6 of document D2 by the presence of one translatable and one fixedly mounted Wollaston prism instead of the matched pair of Wollastons, the examining division defined the technical problem underlying the arrangement in Figure 6 of D2 in the light of the reliance of this arrangement on the presence of an extended light source and a detector array. Should these not be available, the skilled person would opt for an arrangement with a translatable Wollaston prism because, according to the division, "D2 explicitly explains that a movable Wollaston prism is a straight forward alternative to using an extended light source (column 2, lines 12-43)" (*Communication 0f 08-08-2007, point 3.1*).

3.2.10 The board finds this reasoning unpersuasive for the following reason. The skilled person would, upon consulting document D2, understand that the gist of the invention in document D2 resides in a Fourier Transform

spectrometer in which "the use of an extended light source permits a Fourier transform spectrometer with no moving parts to be achieved", see the Abstract, last sentence. This is also expressed in the independent claims 1, 11 and 12 of this document, in which the presence of an extended light source is defined. Therefore, should the skilled person in its instrumentation not have the possibility of using an extended light source and a detector array he would most probably disregard document D2.

3.2.11 It is remarked that Figure 3 of this document D2 also shows a "basic implementation" (col. 1, l. 60) of a Fourier transform spectrometer which is translatable and resembles the arrangement in Figure 1 of document D3, previously discussed. It is interesting to note that the inventors of D2, although having the knowledge of the effect of an inclined plane on the splitting points in a single Wollaston (col. 3, l. 54 - col. 4, l. 17), did not apparently see any necessity to compensate for this effect in the arrangement of Figure 3. Furthermore, even if they would have proposed to compensate for this effect, the only solution proposed in this document in the context of Figure 6 is to replace the single Wollaston prism by a matched prism pair (col. 4, l. 7 and 8), which is a "double Wollaston prism" (col. 4, l. 8). However, as in the case of the arrangement of document D3, Figure 1, by replacing the single (translatable) Wollaston prism in the apparatus of Figure 1 of D2 by a "matched prism pair" constructed as a "double" Wollaston prism, which would be translatable in its entirety, such a device would not show the features of the apparatus defined in claim 1. This is because this arrangement defines that one Wollaston prism is mounted for movement perpendicular

to the axis of the apparatus and a second (or further) splitters being rigidly mounted against movement.

3.2.12 The combination of these Wollaston prisms results in particular in an advantageous optical gearing (*see page 11, 1st para of the published patent application*).

4. Accordingly, the board finds that the subject-matter of claim 1 involves an inventive step (Art. 52(1) EPC and 56 EPC).

The further claims 2 to 8 are dependent claims and are therefore equally allowable.

This conclusion similarly applies to independent claim 9 which defines the use of the apparatus defined in the former claims.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following documents:

Claims: 1 to 9, submitted under cover of a letter dated 2 February 2009;
Description: pages 1, 5 to 10 as published; pages 3a, 4, 11, 12 filed with telefax

on 12 December 2007;
pages 2, 3 submitted under cover of a letter dated 2 February 2009;
Drawings: sheets 1/4 to 4/4 as published.

The Registrar: The Chairman:

D. Meyfarth A. G. Klein

Decision electronically authenticated