BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen
(D) [ ] No distribution

D E C I S I O N
of 21 January 2002

Case Number: T 0005/98 - 3.4.2

Application Number: 88115207.8

Publication Number: 0307940

IPC: G01N 15/10, 21/39, 31/34, 33/00, G02B 27/00

Language of the proceedings: EN

Title of invention:
Non-destructive optical trap for biological particles and method of doing same

Patentee:
AT&T Corp

Opponent:
Palm GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Claim 1 (main and auxiliary request) - lack of inventive step (confirmed)"

Decisions cited:
G 0004/95

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0005/98 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 21 January 2002

Appellant: (Proprietor of the patent)
AT&T Corp.
32 Avenue of the Americas
New York
NY 10013-2412 (US)

Representative:
Blumbach, Kramer & Partner GbR
Patentanwälte
Alexandrastrasse 5
D-65187 Wiesbaden (DE)

Respondent: (Opponent)
Palm GmbH
Sudetenstr. 22
D-82515 Wolfratshausen (DE)

Representative:
Branzer, Hans-Jörg, Dipl.-Ing.
Kraus & Weisert
Patent- und Rechtsanwälte
Thomas-Wimmer-Ring 15
D-80539 München (DE)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 3 November 1997 revoking European patent No. 0 307 940 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: M. A. Rayner
V. Di Cerbo

Summary of Facts and Submissions

I. The appellant (=patent proprietor) lodged an appeal against the decision of the opposition division revoking the European patent number 0 307 940 (application number 88 115 207.8). The priority date claimed for the patent is 17 September 1987. The following documents are included in the appeal proceedings:

D1: Science, vol. 235, No. 4795, 20 March 1987, pp. 1517-1520, Ashkin et al.

E1: Laser in Medical Science, vol. 1, 1986, pp. 47-66, Boulnois.

E3: Nature, vol. 330, No. 6150, pp. 769-771, 24 December 1987, Ashkin et al.

D4: Nature, vol. 368, pp. 667-669, 14 April 1994 Schütze et al.

In the decision under appeal, the opposition division considered the subject matter of independent claim 1 as granted to lack an inventive step. The opposition division held that the subject matter of claim 1 differs from the disclosure of document D1 only in that the wavelength of the optical trap generating laser is in the range 0,8 to 1,8 µm, and that this feature does not involve an inventive step on the basis of the suggestion of document D1 that the optical damage of biological particles confined in the optical trap may be avoided by using other laser wavelengths. The choice of laser wavelength in the claimed wavelength range was arrived at by normal experimentation rather than being based on an inventive step. Furthermore, a drop in

absorption of biological material made up mostly of water at near infrared wavelength was known from other documents (one document mentioned in this context was document E1). Thus the subject matter of claim 1 did not involve an inventive step in view of the problem and solution suggested in document D1 and combined with the document E1.

The appellant requested setting aside of the decision and oral proceedings. The respondent (opponent) requested the board to dismiss the appeal.

II. According to the statement setting out the grounds for appeal, none of the documents of the prior art teaches an optical trap operating with the particular infrared laser wavelength range of claim 1 together with the nondestructive confining capability of the optical trap for biological particles. The 0.5145 mm green argon laser of the optical trap reported in document D1 completely or partially destroyed the trapped biological particles. As both high power (100 mW or more) and low power (10 to 20 mW) caused damage, the high laser intensity was not the cause of the destruction of the biological particles. Document D1 does disclose that "it might be advantageous to use other wavelengths" to avoid damage caused by the green argon laser; however, no information is given as to the wavelengths to be used nor as to the search direction for a possibly appropriate wavelength for the nondestructive optical trapping of biological particles.

Furthermore, the fact that no one came forward with a different wavelength to those suggested in document D1 by the inventors of the patent in the period between the publication of document D1 in late March 1987 in

the prestigious *Science* and the publication of document E3 on 24 December 1987, after the priority date of the patent and also by the inventors of the patent and reporting the use of a laser wavelength of 1060 nm for nondestructively trapping biological particles, clearly shows that it was not obvious at that time to find a non-damaging laser wavelength for optically trapping biological particles. The authors of document D4, published after the priority date of the patent, gave with reference to document D3 no less than high praise to the work of the inventors.

Document E1 discloses the effects of the photobiological interaction of laser radiation with living tissue, and not with biological particles. In addition, this interaction can be photochemical, thermal, photoablative and electromechanical, and the associated effects are reported in the document as being damaging and destructive for the living tissue. Even though the document refers to a therapeutic window, the document is only directed to the damaging effects of the exposure of living tissue to laser radiation. In addition, since document E1 does not relate to optical traps at all and involves biological matter undergoing change or the damage of biological tissue as opposed to nondestructive uses of biological particles as claimed in the patent, a solution to the non-damaging laser wavelength problem formulated in document D1 can only be seen with hindsight.

The affidavit dated 3 May 1989 and its annexes indicate that the inventors of the patent searched for nondestructive wavelengths away from the 0.5145 mm in both directions, testing different laser wavelengths and different types of bacteria and viruses and scrutinizing the corresponding damaging and trapping

characteristics, and that the significant move took place, with a laser wavelength of 1.06 mm, an increase of 100% over the wavelength value disclosed in document D1. It therefore took a significant effort to reach success.

III. The respondent referred to the detailed arguments set forth in the grounds of opposition. Document D1 gives a clear indication to search for other non-damaging wavelength ranges, independently of any other consideration relative to the influence of the laser intensity on the damaging effects of the biological particles. The use of wavelength values within the near infrared to avoid optical damage of biological particles confined in the optical trap is obvious in view of the disclosure of document E1 as reasoned by the opposition division.

IV. Oral proceedings were appointed on 21 January 2002, consequent to the auxiliary request of the appellant. In an annex to the summons to oral proceedings, the board informed the parties that it was intended, if possible, to resolve all outstanding issues enabling a decision to be taken at the end of the oral proceedings. If further submissions were to be filed, this should be done promptly (at least one month before the oral proceedings). The board further informed the parties that late submissions of any description from either side, especially if so complex as to delay unduly or prevent resolution of the case at the oral proceedings, ran the risk of not being taken into consideration by the board. The board queried the applicability of a teaching in document D1 concerning ultraviolet absorption to bacteria and observed that claim 3 did not quantify any wavelength range.

In a letter dated 19 December 2001, the respondent informed the board of the intended attendance of Frau Dr Karin Schütze und Herr Raimund Schütze and requested their participation in the proceedings.

Late Filings

In a letter dated 9 January 2002 (i.e. after one month before the date set for oral proceedings), the appellant filed an affidavit (=late filing 1).

In a letter dated 11 January 2002 (=late filing 2), the appellant informed the board that it was intended that two accompanying persons, Mr Ashkin, an inventor, and Mr McCabe would participate in the oral proceedings.

In a letter dated 15 January 2002 (=late filing 3), the appellant filed a further affidavit.

In a letter dated 17 January 2002 (=late filing 4), the appellant filed three auxiliary requests for consideration at the oral proceedings.

V. During the oral proceedings, the appellant initially requested maintenance of the patent on the basis of the main request (claims as granted) or alternatively on the basis of auxiliary requests 1 to 3 (late filing 4).

Admissibility of late filings

The appellant requested admission of the late filings in the discretion of the board because the appellant had no chance to recover the case should it be lost before the board, whereas the respondent in the reverse situation had the possibility of a nullity action. Mr McCabe is an employee of the appellant and Mr Ashkin,

as inventor, could make a special contribution in relation to background knowledge.

The respondent requested that the board refuse to admit anything filed after the date of one month in advance of the oral proceedings as set by the board in the communication accompanying the summons. This was necessary from the point of view of fair treatment of the parties. Further filings could have been made while the case had been dormant before issue of the summons to oral proceedings. When the case again became "current" on issue of the summons, the respondent had, despite the commitments of the persons involved, been able to prepare the case in good time.

The board took the line that it would, in its discretion, admit the second auxiliary request. While the persons accompanying the representative of the appellant (late filing 2) were not permitted by the board to make presentations during the oral proceedings, the board nevertheless offered and the representative of the appellant took time to consult with them about the issues under discussion during the presentation of the case of the appellant.

Novelty and inventive step

The appellant underlined that no wavelength other than 0.5145 mm and especially no infrared wavelength was mentioned in document D1. Moreover, it was stressed that claim 1 of the patent in dispute requires a non-destructive confinement. This means that particle motility is preserved and reproductivity of the particles is maintained. While optical damage was not seen in the case of viruses, neither the viability of the viruses nor the reproductivity of the bacteria was

checked according to the disclosure of document D1, so that non-destructive confinement is not disclosed. Moreover, the specialists in the field had not reacted to document D1 but only to subsequent document D3. The skilled person had simply put the disclosure of document D1 aside.

The respondent argued during the oral proceedings that the patent in dispute concerned no more than a wavelength selection. Document D1 showed that reduction of energy is the important criterion in avoiding damage and characteristic of a longer wavelength. Moreover Figure 2 of document E1 demonstrates that water absorption in the near infrared is several orders of magnitude less that in the far infrared, being thus for practical purposes negligible and consequently available for biological applications.

Presentation made by Frau Schütze (technical expert)

The scientific importance of the work of Mr Ashkin in the field of laser traps and the realisation that biological particles could be trapped was fully recognised. However, what was being considered in the present case was simply the choice of a particular laser wavelength range, which was not difficult for the specialist in the biomedical field as the wavelength dependent interaction between lasers and biological matter was at that time well known. In particular, it was well known that ultraviolet radiation was too hard and that far infrared had too great a heating effect. It is known to the specialist that differing products generated according to biological mechanisms of different cells lead to the cells concerned being damaged by differing laser wavelengths. Where water containing biological particles are in a water

environment, the skilled person also knew both that an increase of temperature around 1°C can be tolerated and that heat energy generated is readily transported away by the surrounding medium. The skilled person was therefore able to live, for example, with the water absorption of a YAG laser. Thus, the wavelength chosen results from an appropriate compromise for the biological particle concerned.

Final requests of the parties

The appellant requested the board to maintain the patent based on his main or sole auxiliary request, the latter being identical to the hitherto second auxiliary request. The respondent maintained the request for dismissal of the appeal.

VII. Claim 1 according to both the main and auxiliary request of the appellant is worded as follows:

Main request

1. Apparatus for generating a single-beam gradient force optical trap of particles, said apparatus comprising a laser for generating a light beam at a predetermined wavelength and means for focusing said light beam with sufficient convergence to form said optical trap in a predetermined region, said apparatus characterized in that
said predetermined wavelength is substantially included in the infrared range of wavelengths between 0.8 mm and 1.8 mm inclusively, so that said trap non-destructively confines at least one biological particle.

The wording of independent claim 3 is not given for the reason given in point 4.6 below.

Auxiliary request

Claim 1 of the auxiliary request is worded identically with that of the main request (as was also the case for the auxiliary requests filed in advance of the oral proceedings but not pursued by the appellant). As with the main request, the wording of independent claim 3 is not given since, for the reason given in point 5 below, it is not dealt with in the present decision.

VIII. 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. *Admissibility of late filings (Article 114(2) EPC)*

The board does not consider the effect of any for the appellant negative decision as a justification for failing to file submissions in good time because, were this a persuasive reason, a patentee could always file late, so that in the interests of equal treatment of the parties, late filings would always have to be admitted, which would amount to an intolerable situation. Accordingly, the argument of the appellant during the oral proceedings and relating to admissibility of the late filings failed to persuade the board to use favourably its discretion in a blanket way. Nevertheless, the board formed the view that the second of the auxiliary requests, as it was concerned with the specific wavelength range mentioned by the board in the summons, could be admitted as response

thereto.

The first and third auxiliary requests include a feature relating to grabbing first and second portions of one of the biological particles, so that not only fresh issue of novelty and inventive step but also new and complex issues relating to clarity and support of the amendments were raised just before the oral proceedings. In the case of the affidavits, the board did not consider them a response to its doubts about applicability of the teaching in document D1 concerning ultraviolet absorption to bacteria, as this subject matter is not mentioned therein. In these cases, the board accordingly resolved the risk of the late submissions not being taken into account as mentioned in the communication accompanying the summons to the disadvantage of the appellant.

The request for participation of the persons accompanying the representative of the appellant amounts to a request within the meaning of point 2(b)(iii) of the head note of decision G4/95 of the Enlarged Board of Appeal because it was not made in good time and the opposing party disagreed to the making of submissions. Accordingly, such presentations were not permitted.

3. *Main request*

Novelty

3.1 Document D1 relates to optical trapping and manipulation of viruses and bacteria by laser radiation pressure. According to the middle column on page 1517 of document D1, a single beam gradient trap consists of a single strongly focussed Gaussian laser beam having a

Gaussian transverse intensity profile. Basic scattering forces and gradient force components of radiation pressure are configured to give a point of stable equilibrium located close to the beam focus. Particles are confined transverse to the beam axis by the radial component and stability in the axial direction is achieved by strong beam focussing such that an axial gradient force component pointing towards the beam focus dominates over scattering forces trying to push the particles out of the trap. An argon laser (0.5145 mm) is show in Figure 1 as used for trapping tobacco mosaic viruses (TMV). A conclusion drawn in the right hand column of page 235 is that it is possible to trap viral material without any gross optical damage. The viability of the virus after trapping was not examined. It is stated that for virus particles, the fact that the strong optical absorptions are in the ultraviolet, probably contributes to their optical stability in the visible light range.

In experiments, the appearance of strange new particles was noticed in diluted samples that had been kept around for several days. They were apparently self propelled and their numbers increased rapidly as time went by. Under examination by an optical microscope, they were identified as rod-like motile bacteria. According to the middle column of page 1519, it was possible to trap one of the bacteria. To help capture the bacteria the laser power was set at ~50 mW. Once the bacterium was captured the power was quickly lowered to ~5 mW to reduce the possibility of optical damage. The bacterium propelled itself around in the trap. After ten minutes the power was raised to 100 mW which was seen as sufficient to kill the bacterium. Free swimming bacteria were captured and released as the trapping beam was blocked according to the top of

the right column on page 1519. According to the left column on page 1520, subsequent experiments were performed with E-coli bacteria, which are much less motile. These bacteria could be captured and manipulated rapidly with powers as low as a fraction of a milliwatt with no apparent change in behaviour or appearance. At powers of 100 mW or more it was possible to observe a shrinkage as the E-coli became optically damaged in a time of about 1 minute. With yet another sample of highly motile bacteria a gradual loss in motility in about a half-minute was observed with powers as low as 10 to 20 mW. In all cases where optical damage was observed with the green argon laser line (514.5 mm) it might be advantageous to use other wavelengths.

3.2 Having regard to the disclosure of document D1, the subject matter of claim 1 is thus novel by virtue of the recitation of a light beam at a predetermined wavelength substantially included in the infrared range of wavelengths between 0.8 mm and 1.8 mm inclusively.

4. *Inventive step*

4.1 The problem addressed by the selection of wavelength range according to claim 1 is avoiding damage to trapped biological particles.

Document D1 discloses that *in all cases* where optical damage was observed, it might be advantageous to use *other laser wavelengths*. It is obvious to the skilled person in view of the different bacteria disclosed in document D1 and their differing behaviour that the teaching relating to *all cases* cannot exhaust itself with trying for example just one different wavelength, but that other wavelengths should be employed as

appropriate on a trial and error basis and according to which biological particles are tested for the purpose of avoiding optical damage. Dependent upon the biological particle concerned, use of near infrared as a non-damaging wavelength follows from this trial and error procedure leading in an obvious way to the subject matter of claim 1, which is thus not considered to involve an inventive step.

4.2 While proceeding on the trial and error basis mentioned in point 4.1 obviously leads by itself to the near infrared, a second approach is to call on the knowledge of the skilled person in the biomedical field in relation to choosing a wavelength to meet the constraint that *in all cases* where optical damage was observed, it might be advantageous to use *other laser wavelengths*. This skilled person knew that ultraviolet radiation is too hard and that far infrared causes too much heating because laser absorption at different wavelengths for biological matter and also for water had already been studied. An example of results of such studies is given in Figure 2 of document D2, from which it can be seen for example that the biomatter absorption generally decreases with increasing wavelength in the permissible region. While it is true that the figure shows water absorbs near infrared radiation, it is also true that the value on the logarithmic scale for example for a near infrared YAG laser is around 10^{-1} compared with between 10^{2} and 10^{3} further into the infrared (2-3 mm). In the view of the board and as confirmed by the technical expert of the respondent, the skilled person considers such small water absorption levels to lead only to heat generation well within the tolerance of the biological particles containing water and in a water environment. Thus while an optimal solution would be no absorption from either

the biomatter or the water, the real world situation is that a compromise between the water and biomatter absorptions is made in a range extending into the near infrared. The board therefore reached the conclusion that a person skilled in the field of biomedicine following the second approach short circuits the trial and error procedure and reaches even more quickly the obvious subject matter of claim 1.

4.3 The main line of argument of the appellant in support of inventive step is anecdotal and relies on explaining how the infrared wavelength was actually reached, and, in particular, that wavelengths other than the near infrared were tried first. This line of argument does not persuade the board as it involves doing no more than what is foreshadowed in document D1 and thus amounts to an illustration of the trial and error approach outlined in point 4.1 above. Moreover, even accepting that the trial and error procedure took around nine months, i.e. the time period between the publication documents D1 and D3, before reaching success, this period is in the view of the board typical and not so excessive as to bolster up the inventive step of the procedure. This view is reinforced by no period shortening biomedical knowledge as mentioned in point 4.2 being taken into account.

4.4 The appellant also argued that the skilled person would have put document D1 to one side. This argument relies on the premise that a non-destructive confinement, in the sense of the not specifically claimed feature of preserving motility and reproductivity of the trapped particles, is not provided according to the teaching of document D1. While it is true that higher laser powers damage or kill bacteria as is explained for example in the bottom third of the middle column on page 1519

(rod-like bacterium) or the middle of the left column on page 1520 (E-coli), the approach of the appellant implies that complete or partial destruction of bacteria at all power levels is believed inevitable by the skilled person. However, since at low laser powers, document D1 teaches the E-coli bacteria can be captured and manipulated rapidly (at a power of a fraction of a milliwatt) with no apparent change *in behaviour* or appearance, a rod-like motile bacterium *propels* itself around in the trap (at a power of ~5 mW) and *free swimming* bacteria can be trapped and released, the board considers it obvious that a nondestructive trap was indeed provided in these cases and the approach of the appellant in error. The board therefore does not accept the premise of the appellant and does not consider document D1 would have been put on one side.

4.5 Another line of argument of the appellant in support of inventive step is that a near infrared wavelength is not specifically given in document D1. This argument misses the point as it is directed to novelty and not inventive step. The challenge of the appellant against the pertinence of document E1 because of pertaining to laser treatment and not mentioning optical traps also fails to convince the board, because Figure 2 of document E1 in the present context is illustrative only of the general knowledge of the skilled person pertaining to laser interactions with water and some biological substances and shows some known results. The board observes that the skilled person is not bound by the treatment mentioned in document E1 to understanding from Figure 2 in the light of his general knowledge that laser radiation can only destroy, especially as it was known from document D1 that this is not the case for the bacteria mentioned in point 4.4 above. The board does not consider arguments relating to post

published document D3 as relevant to inventive step and remarks in particular that it sees no contradiction between describing optical tweezers as revolutionary in the third paragraph of the left column on page 667 of post published document D4, while not recognising any invention in per se selection of infrared for example as mentioned 10-13 lines later in the same paragraph.

4.6 Since the main request contains a claim (claim 1) which is not allowable since its subject matter is considered to lack an inventive step within the meaning of Article 56 EPC, the request is unsuccessful for this reason and consideration of the other claims in the request is thus unnecessary.

Auxiliary request

5. Since this request contains a claim 1 identical to that of the main request, the auxiliary request is not successful for a corresponding reason.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini