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# D E C I S I O N
## of 25 October 1993

**Case Number:** T 0528/92 - 3.4.1

**Application Number:** 84100970.7

**Publication Number:** 0123025

**IPC:** G21K 4/00

**Language of the proceedings:** EN

**Title of invention:**
Radiation image storage panel

**Patentee:**
Fuji Photo Film Co., Ltd.

**Opponent:**
Siemens AG

**Headword:**
-

**Relevant legal norms:**
EPC Art. 56

**Keyword:**
"Inventive step: main and first auxiliary request (no)"
"Inventive step: second auxiliary request (yes)"

**Decisions cited:**
T 0206/89

**Catchword:**
-

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**Case Number:** T 0528/92 - 3.4.1

# D E C I S I O N
## of the Technical Board of Appeal 3.4.1
## of 25 October 1993

**Appellant:** (Opponent)
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**Representative:**
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**Respondent:** (Proprietor of the patent)
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**Decision under appeal:** **Decision of the Opposition Division of the European Patent Office dated 7 April 1992 rejecting the opposition filed against European patent No. 0 123 025 pursuant to Article 102(2) EPC.**

**Composition of the Board:**

**Chairman:** G.D. Paterson
**Members:** H.J. Reich
R.K. Shukla

## Summary of Facts and Submissions

I. The Respondent is the proprietor of European patent No. 0 123 025.

Independent Claims 1 and 11 as granted read as follows:

"1. A radiation image storage panel comprising a support and phosphor layers provided thereon which comprise a binder and a stimulable phosphor dispersed therein, characterized in that said phosphor layers comprise the first phosphor layer on the support side and the second phosphor layer provided on the first phosphor layer, and that the mean particle size of the stimulable phosphor contained in said first phosphor layer is smaller than the mean particle size of the stimulable phosphor contained in said second phosphor layer.

11. Use of a radiation image storage panel as claimed in any claims 1 to 10 in a radiation image recording and reproducing method comprising the steps of causing the stimulable phosphor of the panel to absorb radiation energy having passed through an object or having radiated from an object;
exciting the stimulable phosphor with an electromagnetic wave to release the radiation energy stored in the stimulable phosphor as light emission;
photoelectrically converting the emitted light to give electric signals; and
reproducing the electric signals as a visible image".

Granted Claims 2 to 10 are dependent on Claim 1.

II. This patent was opposed by the Appellant on the ground of lack of inventive step in view of the prior art which can be derived from documents:

D1: DE-A-3 148 077,
D2: DE-B-2 534 105, and
D3: DE-A-2 263 508.

III. The Opposition Division rejected the opposition since it considered that a person skilled in the art would not combine documents D1 and D2 or D1 and D3 for arriving to the panel of Claim 1 without having knowledge of this panel. The expert knows that in the case of an **intensifying** screen - such as disclosed in documents D2 and D3 - the sharpness of the image obtained depends upon the degree of spread of light, which is spontaneously **emitted** by the phosphor under radiation, whereas in the case of a radiation image **storage** panel - such as disclosed in document D1 - the sharpness of the image obtained depends upon the degree of spread of rays which **stimulate** the emission of light from those parts of the phosphor which store the radiation energy. Therefore, a skilled person would not look to a solution which influences the spread of spontaneously emitted light in the intensifier screen when he desires to reduce the spread of light of stimulating rays in a storage panel.

IV. The Appellant lodged an appeal against this decision citing *inter alia* decision T 0206/89 in order to support his view, that for both technical fields, namely intensifying screens and storage panels, the same skilled person is competent.

V. In response to a communication of the Board annexed to a summons to oral proceedings, wherein the Board expressed its preliminary view that granted Claim 1 might possibly be held as an analogous use of the known effects of the teaching of document D3 in the neighbouring technical field of document D1, the Respondent filed on 24 September 1993 two documents:

Attachment A: "McGraw-Hill Dictionary of Scientific and Technical Terms"; Second Edition, 1978, page 1329, and

Attachment B: L. Levi: "Applied Optics, A Guide to Optical System Design" Volume 2, John Wiley & Sons, New York, pages 93 and 142 to 144,

and a first auxiliary request with a new Claim 1 incorporating mean particle sizes as in granted Claim 2.

Claim 1 of the **first auxiliary** request reads as follows:

> "1. A radiation image storage panel comprising a support and phosphor layers provided thereon which comprise a binder and a stimulable phosphor dispersed therein, characterized in that said phosphor layers comprise the first phosphor layer on the support side and the second phosphor layer provided on the first phosphor layer, that the mean particle size of the stimulable phosphor contained in said first phosphor layer is smaller than the mean particle size of the stimulable phosphor contained in said second phosphor layer and that the mean particle size of the stimulable phosphor contained in the first phosphor layer is in the range of 0.5-10µm, and the mean particle size of the stimulable phosphor contained in the second phosphor layer is in the range of 1-50µm."

Claims 2 to 10 correspond to Claims 3 to 11 of the main request.

VI. Oral proceedings were duly held on 25 October 1993, during which the Board expressed its preliminary view that the Respondent's arguments presented in his letter dated 24 September 1993, page 8, paragraph 1 might be regarded as based on a feature which is not contained in

the subject-matter of Claims 1 of his main and first auxiliary requests. Thereupon the Respondent filed three further auxiliary requests.

Claim 1 of the **second auxiliary** request reads as follows:

> "1. A radiation image storage panel comprising a support and phosphor layers provided thereon which comprise a binder and a stimulable phosphor dispersed therein, characterized in that said phosphor layers comprise the first phosphor layer on the support side and the second phosphor layer provided on the first phosphor layer, that the mean particle size of the stimulable phosphor contained in said first phosphor layer is smaller than the mean particle size of the stimulable phosphor contained in said second phosphor layer and that the density of the particles in the first phosphor layer is larger than that in the second phosphor layer."

Claim 1 of the **third auxiliary** comprises the same wording as Claim 1 of the second auxiliary request up to "smaller than the mean particle size of the stimulable phosphor contained in said phosphor layer" and reads thereafter: "and that the weight ratio of phosphor to binder is within the same range in both phosphor layers".

Claim 1 of the **fourth auxiliary** request adds at the end of the wording of Claim 1 of the third auxiliary request the following feature: ", so that the density of particles in the first phosphor layer is larger than that in the second phosphor layer."

Claims 2 to 11 of the second, third and fourth auxiliary requests correspond to Claims 2 to 11 of the main request.

At the end of the oral proceedings the Appellant (Opponent) requested that the decision under appeal be set aside and that the European patent No. 0 123 025 be revoked.

The Respondent (Patentee) requested that the appeal be dismissed and that the patent be maintained on the basis of the :
main request with the patent as granted, or the first auxiliary request with claims filed on 24 September 1993, or the second, third or fourth request on the basis of Claim 1 so marked and filed during the oral proceedings; and with corresponding amendment to column 2 of the description.

VII. In support of his request, the Appellant made essentially the following submissions:

(a) A skilled person derives from document D1, page 2, line 14 to page 3, line 17 of the description that the sharpness of the image obtained from a radiation image **storage** panel with the features of the precharacterising part of Claim 1 depends upon the degree of scattering of the stimulating rays in the panel. In document D1 the image sharpness is improved by colouring the panel with a colorant which selectively absorbs the stimulating rays. Document D3 teaches that colouring of a phosphor and two phosphor layers having different particle sizes as claimed in the characterising part of Claim 1 of the main request, are equivalent measures for improving the image sharpness in a radiation **intensifier** screen. The scattering

processes of the spontaneously emitted light in the intensifier phosphor layers being influenced by the same physical effects and parameters, it is obvious for a skilled person to make use of the known equivalence and to replace the colouring in the storage panel of document D1 by the differently sized phosphor particles known from document D3.

(b) The storage panels of document D1 and the intensifier screens of document D3 belong to the same technical field. In decision T 0206/89 the Appeal Board 3.5.1 of the EPO held it obvious to obtain advantages in stimulable storage panels by conventional measures of the photographic film technique.

(c) The phosphor particle sizes described in the examples of document D3 (i.e. 1.7µm,2µm,12µm, in the first phosphor layer and 3µm,4.1µm and 35µm in the second phosphor layer) lie within the ranges claimed in Claim 1 of the first auxiliary request, (i.e. 0.5 to 10µm and 1 to 50µm respectively).

(d) A higher particle density in the first phosphor layer as additionally claimed in Claims 1 of the second, third and fourth auxiliary requests, is known from document D3 to be an additional means for improving the image sharpness. This follows in particular from example 1 with a phosphor: binder weight ratio of 15:1 in the first and 10:1 in the second phosphor layer. Hence, also Claims 1 of these requests are obvious in view of documents D1 and D3.

VIII. The above submissions were contested by the Respondent who argued essentially as follows:

(a) As explained in the decision under appeal, in the substantive examination by the Examining Division it is standard practice to consider knowledge of spontaneous phosphors as used in intensifying screens as not transferable to stimulable phosphors as used in storage panels. A broadening effect caused by the scattering of spontaneously emitted light and a broadening effect based on the scattering of stimulating rays are completely different mechanisms. Due to the fact that the stimulating rays travel in the opposite direction to that of the spontaneously emitted light, the effect produced by the two intensifier layers of document D3 on stimulating rays, would not be foreseeable by a skilled person. The opinion of the Opposition Division in the appealed decision, page 5, paragraph 2 to page 6, paragraph 2 (see also point III above) is emphasised to be a technically justified approach.

(b) The increase of image sharpness by colouring and by layers with different phosphor particle sizes are not disclosed in document D3 as equivalent measures. In the use of a colorant, the improvement of resolution is based on the absorption of light and thus on a reduction of the intensifier effect (see document D3 page 2 (printed), paragraph 2. In the use of different phosphor particle sizes, the improvement of resolution is based on differences in the scattering coefficient. When the diameters of the scattering particles are comparable to the wave length of the scattered radiation - as in the case of the embodiments of the patent under appeal - it follows from Attachment B, that the Mie theory must be used to predict scattering. This theory results in a scattering coefficient which tends to vary inversely with the particle radius, which

means that in connection with the present invention the larger particles in the second phosphor layer effect a weaker scattering than the smaller particles in the first phosphor layer.

(c) In the first phosphor layer of the storage panel according to the claimed invention, the stimulating rays have a shorter mean free path and are more often scattered than in the second phosphor layer because of the larger number of small particles. This results in a lesser spread of stimulating rays and thereby in a reduction of the stimulated area in the storage panel seen by the emission collecting means. Hence, a sharper radiation image is produced by reducing the particle size and increasing the particle density in the first phosphor layer; see also the description of the patent under appeal, col. 3, lines 22 to 57.

(d) In order to arrive from the closest prior art according to document D1 at the subject-matter of the present invention a skilled person has to maintain two phosphor layers, cancel the coloured intermediate layer, leave away the colour in the two phosphor layers and to vary the particle sizes in the two phosphor layers on the basis of a different solution principle which is not disclosed in the prior art. The sequence of these four steps can only be carried out with the benefit of hindsight.

## Reasons for decisions

1. *Inventive step of Claim 1 of the main request*

1.1 From the nearest prior art according to document D1, Claims 1 and 13, it is known in the wording of Claim 1

"A radiation image storage panel comprising a support (see D1, page 4, line 19) and phosphor layers provided thereon which comprise a binder and a stimulable phosphor dispersed therein (page 1, lines 1 to 3, and page 30, line 21), characterized in that said phosphor layers comprise the first phosphor layer on the support side (page 4, lines 17 to 24)."

1.2 Starting from the prior art disclosed in document D1, the objective technical problem underlying the patent in suit is to provide a radiation storage panel with an enhanced sharpness of the visible image and with at least the same sensitivity as a conventional panel; see the patent in suit, column 2, lines 40 to 44 and column 4, lines 7 to 17. In a storage panel, image sharpness and panel sensitivity are the two main properties which in practice determine the limits of the usability of the panel. Hence, in the Board's view, the aim to improve these properties is part of the basic routine task of a skilled person in the normal technical development of a storage panel. Thus, the formulation of the objective problem does not contribute to an inventive step underlying the subject-matter of the claims.

1.3 The above problem is solved according to Claim 1 of the main request in that:

"the second phosphor layer is provided on the first phosphor layer, and that the mean particle size of the stimulable phosphor contained in said first phosphor layer is smaller than the mean particle size of the stimulable phosphor contained in said second phosphor layer."

It is not in dispute between the parties that these claimed means of the solution are known from document D3, in particular page 3 (printed), lines 5 to 16 to solve the identical problem in a radiographic intensifying screen.

1.4 In a real life assessment of inventive step, a skilled person concerned with the development of an X-ray image storage panel as in the patent in suit knows that a product for the same user market, i.e. an X-ray intensifying screen, suffers from the same problems as the product he develops himself. Hence, in the Board's view, the storage panel expert can rightfully be expected to consult the field of intensifying screens for advice and to study and analyse in this neighbouring field the known solution of his problem in view of their suitability for his own purposes.

1.5 For the above reasons, the question to be considered is restricted to whether a skilled person is able to recognise and foresee that the teaching of an improvement of sensitivity and sharpness by the use of differently sized phosphor particles in two neighbouring layers would produce the expected technical effect when applied to a storage panel.

1.5.1 Document D1, page 2, paragraph 2 discloses that in the use of an intensifying screen the sharpness of the image detected in a photographic film on top of the screen depends on the degree of scattering (Zerstreuungsgrad)

of light on its way from a spontaneously emitting phosphor molecule to the photographic film. Such scattering in the phosphor layer broadens the film area which is exposed to the emission from the phosphor particles. The fact that the scattering power of particles is a function of their size, clearly belongs to a skilled person's basic knowledge. Hence, the Board regards a skilled person to be able to recognize that the gist of the teaching of document D3 is a reduction of scattering power along the effective optical path realised by changing the particle size. In the case that the expert finds that the Mie-theory applies also to his experimental set up, he will - as in document D3 - reduce the scattering power by the use of larger particles along the effective optical path which in document D3 mainly comprises the second phosphor layer.

1.5.2 On the other hand, document D2, page 2 paragraph 2 to page 3, paragraph 1 discloses that the image sharpness which is obtainable from a storage panel in a detector, depends on the degree of scattering (Zerstreuungsgrad) of the **stimulating** rays in the phosphor layer. Such scattering broadens the stimulated phosphor layer area of the panel, the emission of which is triggered within the same given time and integrally transformed into a pixel element of the detector. From such explanation a skilled person concludes easily that he has to look for means which reduce the scattering of a stimulating ray on its effective optical path from the phosphor layer surface near to the detector to its place of absorption in a metastably excited phosphor molecule.

1.5.3 Hence, document D1 leads a skilled person to the understanding that the limit of resolution of a detectable image in both the intensifier screen and storage panel technologies is determined by information from a ring shaped area, produced by scattering and

surrounding a central ideal picture element formed by an unscattered photon. In the intensifying screen the resolution-determining photon travels from the spontaneously emitting molecule to the photographic film where its absorption sensitizes the film. In the storage panel this photon travels from the detector-near surface to a metastably excited molecule, where its absorption triggers the detected light emission. In the Board's view, a skilled person would easily see the analogy between the scattering -caused annular area exposed in the photographic film around the unscattered ideal picture element and the scattering-caused annular storage panel area surrounding the cross section of the unscattered stimulating beam as seen by the detector. It would also be evident to the skilled person that the effective optical path on which the sensitizing or stimulating photon may be scattered in the intensifying screen or storage panel respectively comprises the phosphor layer region near to the photographic film or detector. It thus has approximately the same relative position within the respective phosphor layers in both technologies.

1.5.4 Contrary to the Respondent's argument in paragraph VIII(a) above, the particular direction in which a photon travels along a given optical path has no influence on its scattering, only the scattering power of the material along this path is relevant. Hence, within the validity of the Mie-theory a skilled person sees no hinderance, why larger phosphor particles - such as in the second phosphor layer of document D3 - should not exercise their reduced scattering power onto a photon which later is absorbed in order to stimulate emission instead of being absorbed in order to sensitise a photographic emulsion. In both cases the absorption only stops the travelling of the photon and is without any effect on its former scattering acts.

1.5.5 Hence, when providing a first and second phosphor layer with the particle sizes disclosed in document D3, in the storage panel disclosed in document D1, this layer configuration will foreseeably not only narrow the width of the annular ring produced by scattering in the photographic film on top of the intensifying screen of document D3 but also of the annular ring produced by scattering in the storage phosphor layer of the panel seen by the detector in document D1 and thus reduce lack of sharpness of the detectable image obtained by both technologies. Claim 1 of the main request is not restricted to any particular phosphor particle densities. For this reason, the Respondent's arguments according to paragraph VIII(c) have no bearing on the decision to be taken with regard to the Respondent's main request.

1.6 The above analysis of the elementary processes in the conventional intensifying screen on the basis of document D3 and those in a storage panel on the basis of document D1 are based only on the skilled person's basic knowledge of physics. This analysis, in the Board's opinion, enables a skilled person to foresee that a larger phosphor particle size for improving sensitivity and image sharpness as disclosed in document D3 will effectively solve the identical problem in the device disclosed in document D1.

1.7 For the reasons set out in detail above, the subject-matter of Claim 1 of the main request is held to be the result of the analogous use of the known properties of the phosphor particle size distribution disclosed in document D3, in the storage panel disclosed in document D1. Therefore, in the Board's judgment, Claim 1 of the main request lacks an inventive step within the meaning of Article 56 EPC.

2. *Inventive step of Claim 1 of the first auxiliary request.*

2.1 Claim 1 of the first auxiliary request specifies in addition to the subject-matter of claim 1 of the main request the explicit ranges of the phosphor particle sizes in the first and second phosphor layer. The examples of document D3 disclose for the first phosphor layer phosphor particle sizes of 1.7µm and 2µm which lie within the claimed region of 0.5 to 10µm, and for the second phosphor layer phosphor particle sizes of 3µm, 4.2µm and 35µm which lie within the claimed region of 1 to 50µm. These conventional sizes give a skilled person sufficient guidance to find out by routine trials the range of the particle sizes which leads to a result which still is acceptable. The patent in suit does not disclose that the claimed size limits define a region with a particular unexpected effect. Hence, the additional subject-matter of Claim 1 of the first auxiliary request has to be regarded as the result of an arbitrary selection, which is obvious to a skilled person.

2.2 For the reasons set out in detail in paragraphs 1.1 to 1.7 and 2.1 above, Claim 1 of the first auxiliary request is considered to lack an inventive step within the meaning of Article 56 EPC.

3. *Inventive step of Claim 1 of the second auxiliary request.*

3.1 Claim 1 of the second auxiliary request starts, as does Claim 1 of the main request, from the closest prior art according to document D1. Neither document D1 nor any other document cited during the present proceedings describes a radiation image storage panel having neighbouring phosphor layers with differing particle

sizes and densities. For these reasons Claim 1 of the second auxiliary request is novel in the sense of Article 54 EPC. Novelty has moreover never been an issue in the present appeal proceedings.

3.2 Claim 1 of the second auxiliary request solves the same objective problem as Claim 1 of the main request; see paragraph 1.2 above. However, it adds to the technical solution claimed in Claim 1 of the main request (which is realized by phosphor particle **size** differences in the first and second layer only; see paragraph 1.3 above) the following technical means:

"and in that the **density** of the particles in the first layer is larger than that in the second phosphor layer".

This additional feature can be derived from the original description, page 5, lines 21 to 29 and page 18, lines 2 to 5 and lines 20 to 25.

The subject matter of this claim now comprises all technical means which enable the elementary processes on which the solution disclosed in the patent in suit relies, namely the fact that the decrease of image sharpness is prevented by the claimed properties of the **first** phosphor layer, i.e. a large number of phosphor particles having a small size; see the patent in suit column 3, lines 45 to 57. This means with regard to the closest prior art as technical starting point that the scattering power on the support side of the phosphor layer is increased by an enlarged number of scattering centres of (complying with the Mie-theory) higher scattering capacity, so that the mean free path of the stimulating rays between two scattering events is shortened.

3.3 The Board follows the Appellant's view according to paragraph VII(d) above, that this additional element of the solution in Claim 1 of the second auxiliary request is also known *per se* in the intensifying screen disclosed in document D3. Hence, the assessment of inventive step is restricted to the question whether a skilled person is guided by the prior art to find out within the working of the intensifying screen of document D3 that the conventional structure of the known first phosphor layer, in particular its higher phosphor particle density, represents a technical means which improves the sharpness of the detectable image obtained.

3.4 Document D3 is silent about the absorption length of the X-rays in the phosphor layers, so that, in a *prima facie* approach, a homogenous distribution of the spontaneously emitted photons normal to the layer surface can be assumed. Along the path from the emitting phosphor molecule to the photosensitive grain in the photographic film, the phosphor layer region neighbouring the film is additionally traversed by photons emitted from molecules below this neighbouring region. Hence, a skilled person would regard the phosphor layer region neighbouring the photographic film (i.e. the region of the second phosphor layer) as critical for the sharpness of the detected image, whereas the support side (i.e. the region of the first phosphor layer) appears less critical since it is traversed by a relatively few detected photons. As follows from the claims and description of document D3, its teaching is mainly concerned with stepped differences in grain size decreasing towards the support side, without indicating the working of this means. Thus, from his basic knowledge about scattering, a skilled person would only recognise that the solution according to document D3 provides particles with smaller scattering capacity in the region neighbouring the detected image in the film.

Comparing this recognizable gist of the teaching of document D3 with the disclosed densities, the skilled person would only notice the lower phosphor particle density in the critical region neighbouring the detected image as a further support of the claimed solution by a smaller number of scattering centres.

3.5 Document D1, page 2, paragraph 2 informs the skilled person that in an intensifying screen the decisive parameter for image sharpness is the **degree** of scattering (Zerstreuungsgrad) of the light emitted from the phosphor particles. The obvious conclusion drawn from such statement only guides a skilled person to look for means which **reduce** scattering. Therefore, also in the light of the disclosure of document D1 a skilled person would interpret document D3 in the way indicated in paragraph 3.4 above.

3.6 An increase in particle density along the optical path of a photon would have the opposite effect, i.e. enlarge the number of scattering events within a given distance. Document D1 page 2, paragraph 2 teaches that in a radiation image storage panel the decisive parameter for image sharpness is the **degree** of scattering of the rays. Hence, it would make no sense to a skilled person to use in the storage panel disclosed in document D1 a higher particle density in the phosphor layer near to its support as disclosed in document D3, because such a measure would increase the degree of scattering. There is no hint in the prior art to narrow the spread of the stimulating rays by increasing their scattering in the storage phosphor layer.

3.7 For the reasons indicated above, it is not obvious in the Board's opinion to arrive at the principle to conform the travelling path of a stimulating photon to the ideal cylindrical form of the unscattered ray in the

storage layer by enlarging the density of the scattering centres. Contrary to the Appellant's argument in paragraph VII(a) above, the Board sees no effect of the colouring technique for increasing image sharpness that would guide a skilled person to intensify scattering for this purpose. Colouring reduces the spread of photons by shortening their absorption lengths but does not influence the travelling direction of a photon. Hence, in the Board's view it involves an inventive step to maintain the absorption lengths of the stimulating photons and to increase the bending of their path so that they are confined within a close neighbourhood to the ideal cylindrical form of the unscattered ray.

Decision T 0206/89 deals with technically different facts. This case concerns the subtraction X-ray radiography wherein substraction measures are exercised upon an electrical detector signal. They are thus independent from the fact whether this detector signal has been derived from a photographic film or a stimulable phosphor sheet (storage panel).

3.8 For the reasons stated above, in the Board's judgement the subject-matter of Claim 1 of the second auxiliary request involves an inventive step within the meaning of Article 56 EPC.

4. Hence, it follows that Claim 1 of the second auxiliary request is allowable. Dependent Claims 2 to 10 of the second auxiliary request concern particular embodiments of the panel according to Claim 1 and are likewise allowable. The use of the panel as claimed in any of Claims 1 to 10 according to Claim 11 is allowable for the reasons set out in paragraph 3.1 to 3.7 above.

5. Under these circumstances, the Respondent's third and fourth auxiliary request do not come into effect.

## Order

**For these reasons it is decided that:**

1. The decision of the Opposition Division is set aside.

2. The case is remitted to the first instance with an order to maintain the patent in accordance with the second auxiliary request filed during oral proceedings, i.e.

**Claims:** 1 filed on 25 October 1993 as auxiliary request 2,
2 to 11 according to EP-B1-0 123 025;

**Description:** Column 1 and 3 to 15, line 36 according to EP-B1-0 123 025,
Column 2 handed over 25 October 1993;

**Drawings:** Sheet 1 to 4 according to EP-B1-0 123 025.

The Registrar: The Chairman:

M. Beer G.D. Paterson