Examiners' Report Paper B 2011 (Electricity/Mechanics)

1. General considerations

It is noted that references in this text beginning with "GL" are to the Guidelines for Examination at the European Patent Office of April 2010.

1.1. Introduction

This year's paper relates to smoke detectors which generate a smoke alarm signal when a smoke concentration reaches a dangerous level (pars. 001, 002).

The application discusses a prior art smoke detector (par. 003-010, Figs. 1-3) comprising an infrared light source and a sensor which senses the intensity of light from the source that is scattered by smoke particles present within the detecting chamber of the smoke detector. If the intensity of the light sensed by the sensor exceeds a predetermined light intensity threshold value, a control unit generates a smoke alarm signal and a horn sounds.

The application describes the following drawback (pars. 011, 012): For a given smoke concentration, the intensity of the scattered light reaching the sensor depends on the intensity of the light emitted by the light source. With time however, the intensity of light emitted by the source will decrease for reasons such as the source aging, dirt forming on the source, or as the battery becomes depleted. Because the light intensity threshold value is predetermined, the smoke concentration at which the control unit generates an alarm signal also changes with time so that the smoke concentration may exceed a dangerous level without the alarm sounding.

Thus there is a need to optimise the light intensity threshold value with time. The application starts from the position that this drawback is overcome by having the control unit set the light intensity threshold value (see characterising part of claim 1 as originally filed).

1.2. Prior art

The communication cites D1, D2 and D3, all of which relate to prior art smoke detectors using the light scattering effect. D1 and D2 are cited as taking away the novelty of claim 1 as originally filed.

In D1 the drawback is recognised that as the battery ages, the preset light intensity threshold value will no longer be optimal. The solution is to provide a testing block 460 which, when pushed manually into the smoke detector chamber 430, mimics the presence of smoke particles. The user then turns a control knob 410 until it reaches a position at which an alarm signal is generated. In this position, the control unit 425 sets an optimal light intensity threshold value (par. 009).

D1 further mentions that a smoke detector that can carry out this optimisation process automatically is under development (par. 010).

D2 discloses a smoke detector which is arranged to be powered either by a ~~~ or by mains electricity. The control unit 525 determines whether or not a battery ~ fitted (par. 006, Fig. 1). When no battery is detected, the light source emits light o~ higher intensity and the control unit sets a predetermined higher light intensity threshold value. If a battery is detected, the light source emits light of a lower intensity and the control unit sets a lower light intensity threshold value, thereby increasing the battery life.

When the battery is exhausted, the smoke detector of D2 generates an audible warning. To this end, it has a battery power monitoring circuit 528 which generates a power signal representing the power capability of the battery. The control unit monitors the power signal and when it is less than a power-threshold value, the audible warning is generated. The latter is not wanted at night because it is disturbing. Therefore the smoke detector has a second light sensor 550 sensing ambient light and the control unit accordingly sets the power-threshold value to be lower at night (pars. 007-010).

D3 describes a smoke detector having a second light sensor 650 arranged to receive light directly from the light source 642 and to sense the intensity of the received light. When the intensity of light sensed by the second light sensor falls below a light intensity threshold value, the control unit 625 judges that the light source 642 has failed and activates the horn.

1.3. The challenges of the paper

The smoke detector of the application solves the problems of the prior art by providing a smoke detector which sets the optimal light intensity threshold value without requiring regular manual adjustment (see client's letter, second paragraph).

The main challenges of the paper were to:

(a) draft a new independent claim which was:

clear (communication, point 3),

new with respect to the cited prior art (communication, point 4; in particular D1 and D2),

involved an inventive step with respect to the prior art, and

covered all the embodiments of the application;

(b) overcome the objection under Art. 123(2) EPC that amended claim 2 added subject matter (communication, point 5);

(c) provide an appropriate set of fall-back claims covering specific embodiments of the invention (client's letter, third par.) being clear and not adding subject matter beyond the original application; and

(d) write a letter of reply to the EPO which:

responded to all the points made in the communication,

identified all the amendments made to the claims and their basis in the appl[...] as originally filed, and

provided argumentation supporting the patentability of the independent claim.

1.4. The marking scheme

Answer papers are marked on a scale of 0 to 100 marks:

For the claims: Max. 40 marks, min. 0 marks.
20 marks are available for the independent device claim.
20 marks are available for the dependent claims.

For the argumentation: Max. 60 marks, min. 0 marks.

2. Independent claim (up to 20 marks)

See Section 5 for an example amended claim set.
A single independent device claim was expected. Generally it is noted that the marks awarded for an independent claim reflect the degree to which the claim achieves protection for the applicant's invention in its broadest possible scope.

2.1. Example feature set for an independent claim

It is noted that the following is a list of features for a claim and is not arranged in the two part form.

(a) A smoke detector (100, 200, 300) comprising:
(b) an infrared light source (42),
(c) a <u>first</u> light sensor (44) arranged to receive infrared light from the infrared light source (42) which has been scattered by smoke and to sense the intensity of the received infrared light,
(d) a light shield (40) arranged to prevent infrared light from the infrared light source (42) from being directly received by the <u>first</u> light sensor (44),
(e) a control unit (125, 225, 325) electrically connected to the <u>first</u> light sensor (44),
(f) the control unit (125, 225, 325) being arranged to generate a smoke alarm signal when the intensity of infrared light sensed by the <u>first</u> light sensor (44) exceeds a light intensity threshold value, ~~characterised by the method step of the control unit (125, 225, 325) setting the light intensity threshold value.~~
(g) <u>the</u> smoke detector (100, 200, 300) ~~according to claim 1~~ comprising a ~~further~~ <u>second</u> light sensor (150, 250, 350)
(h) arranged to receive light directly from the infrared light source, and to sense the intensity of the received infrared light,
(i) wherein the control unit (125, 225, 325) is electrically connected to the ~~further~~ <u>second</u> light sensor (150, 250, 350), <u>and</u>
(j) <u>the control unit is arranged to set the light intensity threshold value as a function of the intensity of infrared light sensed by the second light sensor (150, 250, 350)</u>.

<u>Notes</u>:
1. This claim comprises the device features of original claim 1 (features (a)-(f)), original claim 2 (features (g), (h), (i)), and feature (j) from the description (pars. 019,

025, 027). With respect to claims 1 and 2: removed features are shown in st... text; added features are underlined.

2. The terms "first" and "second" light sensor (description, e.g. par. 016) are equivalent to "light sensor" and "further light sensor".

3. Regarding feature (j), this feature corresponds to the unclear method step of original claim 1 and develops it further to include the generic relationship between the light intensity threshold value set by the control unit and the intensity of light sensed by the second light sensor which is common to all embodiments. The specific nature of this relationship is not considered to be essential for carrying out the invention since it differs between the different embodiments.

4. Feature (g) renders the claim new with respect to D1, since the device of D1 has a single light sensor.

5. Features (h) and (j) render the claim new with respect to D2, the smoke detector of D2 has a control unit which sets a light intensity threshold value in accordance with the presence or absence of a battery.

6. Feature (j) renders the claim new with respect to D3, the smoke detector of D3 has a control unit which does not set a light intensity threshold value.

7. Full marks could also be obtained with different wording. A single independent device claim was expected. No divisional application was expected; no marks were available for one.

2.2. Amendments not supported by the application as originally filed (Art. 123(2) EPC)

I. **Amendments giving rise to potential Art. 123(2) / 123(3) trap (-16 marks)**

Any independent claim which includes subject matter having no basis in the original disclosure of the application and which could not be deleted in post grant proceedings without broadening the scope of the claim is considered in this section.

II. **Other amendments falling under Art. 123(2) EPC (-12 marks)**

Any independent claim having subject matter that extends beyond that of the application as originally filed, but which could be made compliant with Art. 123(2) EPC in post-grant proceedings without offending against Art. 123(3) EPC, is considered in this section.

Examples:

(1) A claim including the feature "*second light sensor*" but lacking the feature that it is "*arranged to receive light directly from the light source, and to sense the intensity of the received infrared light*" (see point 5.1 of communication) (-12 marks).

(2) A claim which did not specify the light source to be an *infrared* light source has no basis in the application as originally filed (-12 marks).

2.3. <u>Unnecessary limitations</u> (-8 to -12 marks per feature)

An unnecessary limitation in an independent claim is a feature which is not necessary for defining the applicant's invention in its broadest scope and consequently disadvantages the applicant; e.g. one or more preferred embodiments of the invention are excluded from protection. Between 8 and 12 marks are deducted for each unnecessary limitation according to its severity.

<u>Examples</u>:

(1) An independent claim having features (a) to (j) of the example independent claim and additionally including the feature that *the second light sensor and the infrared light source are spaced apart by a gap (X,Y)*. This excludes the first embodiment of the invention. (-12 marks)

(2) An independent claim having features (a) to (j) of the example independent claim and additionally including the features that *the second light sensor and the infrared light source are spaced apart by a gap of greater or equal to 5mm and comprising a signal averaging filter that is arranged to average a light intensity signal it receives from the second light sensor over a period of time*. This claim excludes the first and second embodiments of the invention (-12 marks).

(3) An independent claim having features (a) to (j) of the example independent claim and additionally including the features that *the second light sensor is arranged to sense the intensity of infrared light having a wavelength in the range of 850-900 nm* (-12 marks).

(4) An independent claim having features (a) to (i) of the example independent claim, and the feature "*the control unit is arranged to set the light intensity threshold value to decrease or increase as the intensity of infrared light sensed by the second light sensor decreases or increases respectively.*" The third embodiment of the invention is arguably excluded by this claim since in that embodiment the control unit decreases or increases the light intensity threshold value as the averaged light intensity signal decreases or increases (see application, pars. 26, 27) (-8 marks).

(5) An independent claim having features (a) to (j) of the example independent claim and additionally including the feature that *the smoke detector comprises a detecting chamber*. As explained in D2, par. 13, scattering-type smoke detectors operating with infrared light do not need the detecting chamber (partly formed in D2 by a cover) in order to operate (-8 marks).

2.4. <u>Lack of novelty</u> (-16 marks)

I. **Novelty with respect to D1**

The feature (g) of the example independent claim "*second light sensor*" renders the claimed subject matter novel with respect to D1. The smoke detector of D1 has a single light sensor.

II.   **Novelty with respect to D2**

The feature (h) of the example independent claim "*the second light sensor is arranged to receive light directly from the infrared light source, and to sense the intensity of the received infrared light*" provides novelty over D2. The feature (j) "*the control unit is arranged to set the light intensity threshold value as a function of the intensity of infrared light sensed by the second light sensor*" also provides novelty over D2. The smoke detector of D2 has a second light sensor which senses the intensity of received ambient light (par. 9) and has a control unit which sets a light intensity threshold value in accordance with the presence or absence of a battery (par. 6).

III.   **Novelty with respect to D3**

The feature (j) of the example independent claim "*the control unit is arranged to set the light intensity threshold value as a function of the intensity of infrared light sensed by the second light sensor*" provides novelty over D3. In the smoke detector of D3 the control unit does not set a light intensity threshold value, rather, it activates the horn when it judges that the light source has failed.

IV.   **Independent claim 1 lacking novelty**

Example:

Claim 1 merely amended to clarify that "*the control unit is arranged to set the light intensity threshold value"* is not novel over D1 or D2 (see communication, point 4) (-16 marks).

2.5.   Lack of inventive step (-12 marks)

An independent claim whose subject matter is considered to lack inventive step in the light of the available prior art lost 12 marks.

Examples:

(1) A claim comprising the features (a)-(f) of the example claim, the feature of the control unit being arranged to set the light intensity threshold value and the characterising feature: "*comprising a second light sensor arranged to receive light directly from the infrared light source and to sense the intensity of the received infrared light, the control unit being electrically connected to the second light sensor.*"

This claim is novel with respect to D1 because of the second light sensor, novel with respect to D2 due to the second light sensor being arranged to receive light directly from the infrared light source and to sense the intensity of the received infrared light, and novel with respect to D3 in view of the control unit being arranged to set the light intensity threshold value.

Starting from D1, the claimed smoke detector differs therefrom in that it comprises "*a second light sensor arranged to receive light directly from the infrared light source and to sense the intensity of the received infrared light, the control unit being electrically connected to the second light sensor.*"

The technical effect of this difference is that the control unit can monitor the [ ] of the light source.

An objective technical problem can therefore considered to be: providing a smoke detector which can respond to changes in the output of the light source over time.

D3 teaches a solution to this problem, namely, a smoke detector which gives a warning if the light source fails, whereby a second light sensor is arranged to receive light directly from the light source and to sense the intensity of the received light; the control unit is electrically connected to the second light sensor and monitors the intensity of the light sensed by the second light sensor.

The skilled person would therefore incorporate a second light sensor into the detector of D1 in order to solve the above problem. Consequently the above claim does not involve an inventive step (-12 marks).

(2) Any claim which is rendered new with respect to a prior art document only by virtue of the *particular wavelength of infrared light* used. In all of the documents infrared light is used: D1, par. 4; D2, par. 12; D3, par. 8. There is no statement in the application that any particular wavelength has a surprising effect with respect to those mentioned in the prior art. Therefore a claim specifying one of these wavelengths does not involve an inventive step (-12 marks).

2.6. <u>Lack of clarity /conciseness</u> (up to -8 marks per issue)

Between 4 and 8 marks may be deducted for a lack of clarity issue.

<u>Examples:</u>

(1) A claim having features (a) to (i) of the example independent claim and the feature: *wherein the control unit is arranged to monitor the intensity of infrared light sensed by the second light sensor in order to set the light intensity threshold value*. The relationship between the light sensed by the second light sensor and the light intensity threshold value is unclear (-8 marks).

(2) A claim having features (a) to (i) of the example independent claim and the feature: wherein the control unit sets the light intensity threshold value as a function of the intensity of infrared light sensed by the second light sensor. The latter feature defines an operation carried out by the control unit when in use rather than a device feature of the control unit. This feature only partially overcomes the clarity objection made in point 3 of the communication (-4 marks).

2.7. <u>Formal matters</u> (up to -4 marks)

For an answer paper having an independent claim according to the example solution it is considered appropriate to use the two-part form of claim, thus such an independent claim having a one-part form, or a two-part form of claim which is not consistent with any of the prior art documents, lost 2 marks. For missing or very incomplete reference signs in the claims, up to 2 marks were lost.

2.8. Inferior solutions (up to 12 marks available)

An independent claim which is considered in this section is a claim which:

- offers a less favourable scope of protection for the applicant than the example solution claim, for example because it is contrary to the applicant's wishes;

- misses at least one feature of the example independent claim;

- has at least one feature that is not in the example independent claim; and

- is new and arguably not obvious with respect to the available prior art.

3. Dependent claims (up to 20 marks available)

Generally it is noted that the marks awarded for a dependent claim reflect how challenging the claim is to draft and the degree to which the claim offers a fall back position for the applicant, taking into consideration the independent claim and the prior art.
Important aspects to consider are:
- clarity, e.g. consistency of terminology with the independent claims; and
- claim structure: a set of dependent claims having a good structure offers the applicant an appropriate set of fall back options whilst being concise and having claims with correct back references.

See Section 5 for an example set of dependent claims.

3.1. Maintaining appropriate original dependent claims (2 marks)

It was expected to maintain appropriate dependent claims from the originally filed claims.

Example for an answer paper having the example independent claim:

Dependent claims based on claims 3 and 4 as originally filed would be appropriate (2 marks).

3.2. Claim(s) directed to second embodiment (up to 4 marks in total)

The examiner noted that the term "very small" used in claim 5 was unclear (communication, par. 7.2). The applicant requested that fallback claims be included in the claim set to be filed. Thus it was expected to provide clear claims replacing claims 5 and 6.

Example for an answer paper having the example independent claim:

A smoke detector according to claim .. *wherein the gap (X) is less than 5 mm* (3 marks).

A smoke detector according to the above claim *wherein the gap (X) is 4 mm* (1 mark).

3.3. Claim(s) directed to third embodiment (up to 11 marks in total)

Since the client's letter indicates that smoke detectors according to the third embodiment have advantages, a claim, or claims, thereto were expected.

Example for an answer paper having the example independent claim:

A smoke detector according to claim .. *wherein the gap (Y) is greater than or equal to 5mm*, and wherein the smoke detector comprises a signal-averaging filter that is arranged to average a light intensity signal it receives from the second light sensor over a period of time* (10 marks).

A smoke detector according to claim … *wherein the gap is 50mm* (1 mark).

*Instead of defining the gap as being greater than or equal to 5mm it is considered equivalent to define the gap as being larger than the gap defined in a claim to which reference is made, provided the referenced claim defines a gap of less than 5mm.

Note: Although the client's letter indicates when describing smoke detectors according to the third embodiment that a gap of greater or equal to 5 mm results in a useful smoke detector, a gap of greater or equal to 5 mm was only disclosed in the application as filed in conjunction with a signal averaging filter that is arranged to average a light intensity signal it receives from the second light sensor over a period of time (cf. par. 026).

Example: A claim "x" defining a gap greater or equal to 5 mm without including the feature of the signal averaging filter would not be compliant with Art. 123(2) EPC. claim x would receive 1 mark. A subsequent claim to a signal averaging filter which by its dependency on claim "x" includes the same features as the above example claim would receive 1 mark.

3.4. Other dependent claims offering a useful fall back (up to 3 marks)

Up to 3 marks in total were available for one or more additional dependent claims which offer a useful fall back position or positions, provided the total of 20 marks for the dependent claims was not exceeded. To be awarded marks such a claim must be clear and compliant with Art. 123(2) EPC. The dependent claims appropriate for achieving fall back positions may depend on the independent claim (see the following examples).

Examples:

(1) For an answer paper having an independent claim to a smoke detector which was not new with respect to D3 because the feature that *the control unit is arranged to set the light intensity threshold value as a function of the intensity of infrared light sensed by the second light sensor* was missing or incomplete, a dependent claim to this feature would offer an important fall back option for the applicant (up to 3 marks).

(2) A smoke detector according to claim ... wherein *the control unit decreases or*

increases the light intensity threshold value it sets as the intensity of infrared sensed by the second light sensor decreases or increases respectively (pars. 19,24) (1 mark).

(3) A smoke detector according to claim ... wherein *the signal averaging filter averages the light intensity signal it receives from the second light sensor over a period of 24 hours.* (par. 28) (1 mark).

(4) A smoke detector according to claim ... wherein *the infrared light source is arranged to emit infrared light having a wavelength in the range of 850-900 nm and the first and second light sensors are arranged to sense the intensity of infrared light having a wavelength in the range of 850-900 nm* (par. 29) (1 mark).

3.5. Other dependent claims not considered to offer a useful fall back (0 marks)

It is noted that the features of these claims are known from the prior art and that the skilled person would include these features in the invention defined in the independent claim without making an inventive step. However this is not an indication that the same feature would not be a limitation when present in an independent claim.

Examples:

(1) A smoke detector according to claim ... further comprising a detecting chamber. (0 Marks)

(2) A smoke detector according to claim ... the smoke detector being arranged to be powered by a battery or by mains electricity when available. (0 Marks)

(3) A smoke detector according to claim ... wherein all the surfaces inside the detecting chamber are black. (0 Marks)

3.6. Structure (up to 3 marks)

A set of dependent claims having a claim structure which gives the applicant an appropriate set of fall back options, whilst at the same time being concise and having correct back references, received 3 marks.

Note: where an answer paper has a dependent claim to a gap greater or equal to 5mm and a subsequent dependent claim to a signal averaging filter, as described in Section 3.3 above, up to full marks for structure could have been awarded provided that the claim to the signal averaging filter always includes a gap of greater or equal to 5mm by the dependency defined in the claim.

4. Letter of reply to the EPO (up to 60 marks available)

4.1. General remark

It is noted that the examples for sections of a letter of reply given in the following are in general appropriate for the example claim set. For an answer paper having a different claim set, the letter of reply may differ and the answer paper is considered accordingly.

4.2. Source of amendment showing Art. 123(2) EPC Compliance (16 marks)

The amendments made in the claims are to be identified and a basis for them in the application as filed is to be indicated. Brief explanations may be necessary (see GL E-II,1).

4.2.1. Independent Claim (10 marks)

10 marks were available for indicating and explaining a basis for the independent claim: 2 marks for mentioning the claims used as a basis; 3 marks for a complete basis for the remaining features of the claim; 5 marks are available for the explanation.

Example:

Claim 1 of the example claim set is based on the pre-characterising features of original claim 1 and on original claim 2 (2 marks).

The feature "the control unit is arranged to set a light intensity threshold value and that the smoke detector is arranged to do this as a function of the intensity of infrared light sensed by the second light sensor" (feature (j)) has a basis in the characterising feature of original claim 1 and the description as originally filed with respect to all three embodiments of the invention, see pars. 019, 025 and 027 (3 marks).

The characterising part of original claim 1 is clarified and developed using the description. In the description of the second embodiment (see par. 025) it is stated that the control unit is arranged to set the light intensity threshold value in the same way as in the first embodiment. Finally, it is noted that since the wording of the original claim 2 has been incorporated into claim 1 of the example claim set, rather than that of claim 2 as amended after the receipt of the search report, the objection of added subject matter under Art. 123(2) EPC raised in point 5 of the communication has been overcome. (5 marks)

4.2.2. Dependent Claims (up to 6 marks)

1 mark was available for stating a basis for each of the dependent claims of an answer paper, providing the total does not exceed 6 marks.

For the example set of claims:

Claim	Basis	Marks
2	original claim 3	1
3	original claim 4	1
4	par. 23	1
5	par. 24	1
6	pars. 19, 24	1
7	par. 27	1

4.3. Clarity (up to 6 marks)

The examiner objected to original claim 1 because of a lack of clarity (communication, point 3). Furthermore, referring to claims 5 and 6 then on file, the examiner indicated that the term "very small" had no well-recognised meaning in the field of smoke detectors and was therefore unclear (communication, point 7.2). Answer papers should respond to these points.

Example:
The characterising feature of original claim 1 defined a method step. This feature has been replaced by a corresponding device feature "…wherein the control unit is arranged to set the light intensity threshold value…". Therefore the objection under Art. 84 EPC has been overcome (4 marks).

The claim 5 previously on file has been deleted. A corresponding claim, claim …. where the feature "very small" has been replaced with the clear term "less than 5 mm" has been filed. Therefore this claim is clear (2 marks).

4.4. Novelty of the independent device claim (up to 5 marks)

The examiner objected to original claim 1 because of a lack of novelty in the light of D1 and D2 (communication, point 4). In the example independent claim, one of the features of original claim 1 has been replaced with another feature. Accordingly, an argument as to why this claim is novel with respect to D3 was expected. It is considered sufficient to mention one feature of the independent claim that is not disclosed in each of D1-D3.

Example:

Claim 1 is novel with respect to D1 because D1 does not disclose a smoke detector having a second light sensor (1 mark).

Claim 1 is novel with respect to D2 because, although D2 discloses a smoke detector having a second light sensor, the second light sensor of D2 is not arranged to receive light directly from the infrared light source and to sense the intensity of

the infrared light (2 marks). (Alternatively or additionally: D2 does not disclose control unit arranged to set a light intensity threshold value as a function of the intensity of light sensed by the second light sensor).

Claim 1 is novel with respect to D3 because D3 does not disclose a smoke detector having a control unit which is arranged to set the light intensity threshold value as a function of the intensity of the infrared light sensed by a second light sensor (2 marks).

4.5. Inventive step argumentation for the independent claim (up to 33 marks)

It is appropriate to provide arguments which are structured to follow the problem solution approach (see GL C-IV, 11.5).

4.5.1. Identifying the closest prior art (10 marks)

In selecting the closest prior art, the first consideration is that it should be directed to a similar purpose or effect as the invention, or at least belong to the same or a closely related technical field as the claimed invention (see GL C-IV, 11.5.1).

I. Stating the closest prior art (4 marks)

For stating an item of prior art as being the closest prior art in a consistent manner with the two-part form of the independent claim, up to 4 marks are available.

For the example independent claim, D1 is considered to represent the closest prior art; for a clear statement to this effect, up to 4 marks are available.
The smoke detectors of D2 and D3 are considered to be less relevant. For a statement identifying D2 or D3, 1 mark is available.

When the claim of an answer paper differs from the example independent claim, the choice of closest prior art may be different from the above and received marks accordingly. This was decided on a case-by-case basis.

II. Arguments justifying the choice of closest prior art (6 marks)

Irrespective of whether D1, D2 or D3 was chosen as the closest prior art, 6 marks were available for arguments justifying the choice. Of these 4 marks were available for discussing the document chosen as the closest prior art and 1 mark each was available for discussing the other two documents.

Example:

For the example independent claim and where D1 is stated as being the closest prior art:

D1 is the only prior art document available which discloses a smoke detector which has a control unit which sets a light intensity threshold value in order to compensate for a sensed change in the intensity of light emitted by its light source (see D1, pars. 002, 009). Furthermore, D1 states that a smoke detector that will automatically carry out this optimisation process is under development (par. 10). Therefore D1 is directed to a similar purpose as the invention and is the most

promising starting point for an obvious development leading to the invention
(4 marks).

D2 discloses a smoke detector having a control unit which sets a light intensity
threshold value according to whether or not a battery is fitted. However it does this
independently of the intensity of light actually emitted by its light source. (1 mark).

D3 discloses a smoke detector which has the most structural features in common
with the invention. However its control unit does not set a light intensity threshold
value. Therefore its purpose and effect is more remote than that of D1 (1 mark).

4.5.2. Formulation of the objective technical problem (5 marks)

The next stage is to establish in an objective way the technical problem to be solved
(GL C-IV, 11.5.2). This requires the steps of:

I.   identifying, in terms of features, the difference between the claimed invention
     and the closest prior art, i.e. the distinguishing features of the claimed invention
     (1 mark);

II. stating the technical effects or the advantages of the difference (2 marks); and

III. formulating a problem which is solved by this technical effect (2 marks).

   Example:

   The subject matter of amended claim 1 differs from that known from D1 in that:

i.   a second light sensor is arranged for receiving light directly from the light source
     and for sensing the intensity of the received light (features (g), (h)), and

ii. the control unit is electrically connected to the second light sensor and is
     arranged to set the light intensity threshold value as a function of the intensity of
     the infrared light sensed by the second light sensor (features (i), (j) of the
     example independent claim) (1 mark).

   The technical effects of these differences are firstly that the control unit can
   monitor the output of the light source and secondly that the control unit can set a
   different light intensity threshold value in response to changes in the intensity of
   infrared light emitted by the light source (2 marks).

   The objective technical problem can therefore be formulated as: Providing an
   infrared light scattering effect smoke detector, wherein the light intensity
   threshold value at which a smoke alarm signal is generated is automatically
   optimised to compensate for changes in the intensity of infrared light emitted by
   the light source (2 marks).

4.5.3. Arguments in support of inventive step (18 marks)

Arguments should support the features of the independent claim, they should be
convincing and well structured. In order to obtain full marks in this section,
arguments which fully answers the question as to why the skilled person, knowing
the teaching of the prior art as a whole, would not arrive at the subject matter of the

must be presented (GL C-IV, 11.5.3). Such arguments can be structured to considered the following aspects:

- Would the skilled person arrive at the subject matter of the claim by considering the teaching of the closest prior art on its own?

- Would the skilled person consider combining the teaching of the closest prior art with that of other prior art documents in order to solve the objective technical problem?

- If the skilled person were to combine the teaching of the closest prior art with other items of prior art, would they arrive at the subject matter of the claim?

<u>Example</u>:

The following example arguments are for D1 as the closest prior art. Note that where D2 or D3 has been chosen as the starting point, the arguments may be structured differently and other arguments might apply.

Considering D1 on its own (4 marks)

In D1 the light intensity threshold value is set by the control unit to be optimal. This is as a result of a manually executed optimisation process in which a testing block which simulates smoke is pushed into the detecting chamber of the detector, see D1, par. 9. D1 therefore does provide a solution to the problem of how to provide a smoke detector whereby the light intensity threshold value can be optimised to compensate for changes in the intensity of light emitted by the light source. However this solution is not automatic and does not involve the use of a second light detector.

Although D1 hints that the optimisation process could be automated, no details are given as to how this could be achieved. If the skilled person were to automate the manually executed optimisation process they would merely attempt to automate the steps set out in par. 009 of D1 and would not arrive at a solution using a second light detector.

Considering D1 in combination with D2 (7 marks)

Presented with the objective technical problem the skilled person would recognise that D2 provides a solution to the problem posed, namely to ensure that the light intensity threshold is automatically set differently depending on whether a battery is fitted or not, the different power sources for powering the detector determining different intensities of light produced by the light source. However, in combining the teachings of D1 and D2, the skilled person would arrive at a smoke detector as described in D1 which, additionally, automatically sets a different light intensity threshold value in accordance with the presence or absence of a battery. They would not arrive at the smoke detector as claimed.

Document D2 discloses in par. 007 a condition where intensity of light emitted by the light source decreases, namely when the battery ages. D2 does not

teach compensating for this condition but instead teaches to automatically provide a warning when the battery ages. Although the timing of this warning depends on light sensed by a second light sensor, the sensor senses ambient light and not infrared light from the light source of the smoke detector. Therefore this solution leads away from the solution proposed in the independent claim.

Document D2 discloses in par. 013 a further condition where the intensity of light emitted by the light source decreases, namely when water droplets condense on the light source. However D2 does not propose to compensate this condition by changing the light intensity threshold: instead it proposes manually wiping away the moisture. Therefore this solution leads away from the solution proposed in the independent claim.

Considering D1 in combination with D3 (7 marks)

Presented with the objective technical problem, the skilled person would have no reason to consider combining the teachings of D1 and D3 since D3 does not disclose any compensation for a change in the condition of its light source. Although D3 recognises that the smoke detector will cease to generate an alarm in the event of a fire if the light source has completely failed, it teaches to generate a warning of this condition, not to compensate for this condition (par. 2).

If the skilled person were to combine the teachings of D1 and D3, they would add a second light sensor arranged to receive light directly from the infrared light source. However the control unit would not be arranged to set the light intensity threshold value as a function of the intensity of infrared light sensed, rather the control unit would activate the horn to give a warning if the detected light dropped below a threshold value.

There is no hint in D3 that a second light source could be used to replace one or more of the components specially provided in the smoke detector known from D1 to perform the optimisation process to compensate for changes in the intensity of light emitted by the light source. Thus the skilled person, faced with the objective problem, would not arrive at a smoke detector as claimed.

It is concluded that the invention defined in claim 1 involves an inventive step.

5.   **Example set of claims**

1.   A smoke detector (100, 200, 300) comprising:

an infrared light source (42),

a first light sensor (44) arranged to receive infrared light from the infrared light source (42) which has been scattered by smoke and to sense the intensity of the received infrared light,

a light shield (40) arranged to prevent infrared light from the infrared light source (42) from being directly received by the first light sensor (44),

a control unit (125, 225, 325) electrically connected to the light sensor (44),

the control unit (125, 225, 325) being arranged to set a light intensity threshold value and arranged to generate a smoke alarm signal when the intensity of infrared light sensed by the first light sensor (44) exceeds the light intensity threshold value,

characterised in that the smoke detector (100, 200, 300) comprises a second light sensor (150, 250, 350) arranged to receive light directly from the infrared light source and to sense the intensity of the received infrared light, the control unit (125, 225, 325) being electrically connected to the second light sensor (150, 250, 350) and arranged to set the light intensity threshold value as a function of the intensity of infrared light sensed by the second light sensor (150, 250, 350).

2.   A smoke detector (100) according to claim 1 wherein the second light sensor (150) is physically in contact with the infrared light source (42).

3.   A smoke detector (200, 300) according to claim 1 wherein the second light sensor (250, 350) and the infrared light source (42) are spaced apart by a gap (X, Y).

4.   A smoke detector (200) according to claim 3 wherein the gap (X) is less than 5 mm.

5.   A smoke detector (200) according to claim 4 wherein the gap (X) is 4 mm.

6.   A smoke detector (300) according to claim 3 wherein the gap (Y) is greater than or equal to 5mm and wherein the smoke detector (300) comprises a signal-averaging filter (326) that is arranged to average a light intensity signal it receives from the second light sensor (350) over a period of time.

7.   A smoke detector according to claim 6 wherein the gap is 50mm.

EXAMINATION COMMITTEE I

Candidate No.

Paper B (Electricity/Mechanics) 2011 - Marking Sheet

Category		Maximum possible	Marks awarded	
			Marker	Marker
Claims	Independent	20		
	Dependent	20		
Arguments	Basis for Amendments	16		
	Clarity	6		
	Novelty	5		
	Inventive Step	33		
Total		**100**		

Examination Committee I agrees on .... marks and recommends the following grade to the Examination Board:

☐ PASS
(50-100)

☐ COMPENSABLE FAIL
(45-49)

☐ FAIL
(0-44)

30 June 2011

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Chairman of Examination Committee I