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Datasheet for the decision of 7 February 2014

Case Number: T 0157/13 - 3.5.07

Application Number: 04812375.6

Publication Number: 1697859

IPC: G06F17/00, G05B19/042

Language of the proceedings: EN

Title of invention:
Manufacturing system with intrinsically safe electric information storage

Applicant:
ADVANCED TECHNOLOGY MATERIALS, INC.

Headword:
Manufacturing system/ADVANCED TECHNOLOGY MATERIALS

Relevant legal provisions:
EPC Art. 123(2), 56

Keyword:
Amendments - added subject-matter (no)
Inventive step - (no) (all requests)

Decisions cited:

Catchword:

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Case Number: T 0157/13 - 3.5.07

D E C I S I O N
of Technical Board of Appeal 3.5.07
of 7 February 2014

Appellant:
(Applicant)

Advanced Technology Materials, Inc.
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Danbury, CT 06810 (US)

Representative:

Elsworth, Dominic Stephen
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Decision under appeal:

Decision of the Examining Division of the European Patent Office posted on 8 August 2012 refusing European patent application No. 04812375.6 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: R. Moufang
Members: M. Rognoni
R. de Man

Summary of Facts and Submissions

I. The applicant (appellant) appealed against the decision of the examining division refusing European patent application no. 04812375.6.

II. In the contested decision, the examining division came, *inter alia*, to the conclusion that the main request, the 1^{st} and 3^{rd} to 6^{th} auxiliary requests, all filed with letter dated 18 May 2012, were not in compliance with Article 123(2) EPC. Furthermore, none of the requests met the requirements of Article 52(1) EPC, since the subject-matter of their claims did not involve an inventive step within the meaning of Article 56 EPC. The following prior art was cited:

D1: GB-A-1 470 270
D2: US-A-2002/189667
D3: US-A-4 190 822
D4: US-A-3 527 985
D5: EP-A-0 717 485.

As to the objection under Article 123(2) EPC, the examining division considered that the following feature, recited in claims 1 of the main request and of the 1^{st}, 3^{rd} and 4^{th} auxiliary requests, was not disclosed in the original application documents:

- "*the intrinsic safety barrier is adapted [...] to limit electrical energy passing to the RF antenna without losing the integrity of the RF signals propagating therethrough*".

In the opinion of the examining division, the above feature implied that the signal transmitted to the radio frequency (RF) antenna would not be corrupted, even if the intrinsic safety barrier were limiting the electrical energy flowing through it. The present application taught, however, that the integrity of the RF signals propagating through the intrinsic safety barrier was not lost only when the operating conditions were normal, i.e. when the intrinsic safety barrier was not limiting the passage of electrical energy.

The examining division raised a further objection under Article 123(2) EPC against the following feature recited in claims 1 of the 3rd and 5th auxiliary requests, and in dependent claim 2 of the 4th and 6th auxiliary requests:

- *"the sets of diodes are unbridged".*

In particular, the examining division regarded the above feature as a disclaimer which violated Article 123(2) EPC because it did not represent one of the cases of allowable limitation of the scope of the claim stated in point C-VI, 5.3.11 of the Guidelines in the version applicable at the time.

III. With the statement of grounds of appeal dated 18 December 2012, the appellant filed amended claims according to the main request and according to the 1st, 3rd and 4th auxiliary requests. Furthermore, as 7th, 8th, 9th and 10th auxiliary requests, the appellant submitted an alternative amendment to claims 1 of the main request and the 1st, 3rd and 4th auxiliary requests. The 2nd, 5th and 6th auxiliary requests considered in the contested decision were implicitly maintained.

IV. The appellant requested in writing that the decision under appeal be set aside and a patent be granted based on the claims of the main request as amended on appeal, or based on the claims of the 7th auxiliary request, or based on one of the 1st to 6th or the 8th to 10th auxiliary requests.

V. Further to the statement of grounds of appeal, the appellant submitted with a letter dated 14 February 2013 a declaration made by Mr Kevin O'Dougherty and drew the Board's attention in particular to paragraph 4 of this declaration.

VI. In a communication dated 26 November 2013 accompanying the summons to oral proceedings, the Board expressed, *inter alia*, the provisional opinion that none of the appellant's requests appeared to be allowable.

Furthermore, the Board introduced the following prior art into the appeal proceedings:

D6: EP-A-0 987 646.

VII. In response to the summons to oral proceedings, the representative of the appellant informed the Board with letter dated 16 January 2014 that the appellant withdrew its request for oral proceedings in favour of a decision on the papers, and that they would not be attending the oral proceedings set for 7 February 2014.

VIII. On 7 February 2014 oral proceedings were held as scheduled in the absence of the appellant.

IX. Claim 1 according to the appellant's main request reads as follows:

"A system for controlling, from a non-hazard zone (11, 26), at least one of filling or dispense of a liquid to or from a container (18) in a hazard zone (12, 28), the system comprising:

a radio frequency identification (RFID) tag comprising an electrically programmable storage element (22) adapted to electrically store information;

a radio frequency (RF) antenna (24, 32) adapted to at least one of store information to and read information from the storage element (22);

a controller (14, 44), located in the non-hazard zone (11, 26) and in electrical communication with the radio frequency (RF) antenna (24, 32) adapted to control the system based on communication between the storage element (22) and the radio frequency (RF) antenna (24, 32), and

an intrinsic safety barrier (16) located in the non-hazard zone (11, 26) and operably connected between the RF antenna (24, 32) and the controller (14, 44) adapted to limit electrical energy passing to the RF antenna (24, 32) allowing passage of low energy RF signals to the RF antenna and restricting passage of RF signals having energy greater than a safe threshold energy level to the RF antenna;

characterized in that the RFID tag and the RF antenna (24, 32) are located in the hazard zone (12, 28) and the intrinsic safety barrier (16) is further adapted to allow transmission of the low energy RF signals carrying information between the controller (14, 44) and the RF antenna (24, 32) without losing the integrity of RF signals propagating through said intrinsic safety barrier."

Claim 1 according to the 1st auxiliary request reads as follows:

"A system for controlling, from a non-hazard zone (11, 26), at least one of filling or dispense of a liquid to or from a container (18) in a hazard zone (12, 28), the system comprising:

a radio frequency identification (RFID) tag comprising an electrically programmable storage element (22) adapted to electrically store information;

a radio frequency (RF) antenna (24, 32) adapted to at least one of store information to and read information from the storage element (22);

a controller (14, 44), located in the non-hazard zone (11, 26) and in electrical communication with the radio frequency (RF) antenna (24, 32) adapted to control the system based on communication between the storage element (22) and the radio frequency (RF) antenna (24, 32); and

an intrinsic safety barrier (16) located in the non-hazard zone (11, 26) and operably connected between the RF antenna (24, 32) and the controller (14, 44) adapted to limit electrical energy passing to the RF antenna (24, 32) allowing passage of low energy RF signals to the RF antenna and restricting passage of RF signals having energy greater than a safe threshold energy level to the RF antenna;

characterized in that the RFID tag and the RF antenna (24, 32) are located in the hazard zone (12, 28) and the intrinsic safety barrier (16) is further adapted to allow transmission of the low energy RF signals carrying information between the controller (14, 44) and the RF antenna (24, 32) without losing the integrity of RF signals propagating through said intrinsic safety barrier, wherein the intrinsic safety barrier (16) includes a plurality of forward biased diodes (72, 74, 76) connected in parallel between the controller (14,

44) and ground, and wherein the intrinsic safety barrier (16) further includes a plurality of DC blocking capacitors (80a, 80b) connected in series with the controller (14, 44) and the RF antenna (24, 32)."

Claim 1 according to the 2nd auxiliary request reads as follows:

"A manufacturing system including a hazard zone (12, 28) and a non-hazard zone (11, 26), the system comprising:

a storage element (22), adapted to electrically store information;
a communication device (24, 32), adapted to store information to and read information from the storage element (22);
a controller (14, 44), located in the non-hazard zone (11, 26) and in electrical communication with the communication device (24, 32), adapted to control the system based on communication between the storage element (22) and the communication device (24, 32); and
an intrinsic safety barrier (16) located in the non-hazard zone (11, 26) and operably connected between the communication device (24, 32) and the controller (14, 44) adapted to limit electrical energy passing to the communication device (24, 32),
characterized in that the storage element (22) and the communication device (24, 32) are located in the hazard zone (12, 28) and intrinsic safety barrier (16) is adapted to allow transmission of a signal carrying information between the controller (14, 44) and the communication device (24, 32), wherein

the intrinsic safety barrier (16) includes a plurality of forward biased diodes (72, 74, 76) connected in parallel between the controller (14, 44) and ground, and wherein the intrinsic safety barrier (16) further includes a plurality of DC blocking capacitors (80a, 80b) connected in series with the controller (14, 44) and the communication device (24, 32)."

Claim 1 according to the 3rd auxiliary request reads as follows:

"A system for controlling, from a non-hazard zone (11, 26), at least one of filling or dispense of a liquid to or from a container (18) in a hazard zone (12, 28), the system comprising:

a radio frequency identification (RFID) tag comprising an electrically programmable storage element (22) adapted to electrically store information;

a radio frequency (RF) antenna (24, 32) adapted to at least one of store information to and read information from the storage element (22);

a controller (14, 44), located in the non-hazard zone (11, 26) and in electrical communication with the radio frequency (RF) antenna (24, 32) adapted to control the system based on communication between the storage element (22) and the radio frequency (RF) antenna (24, 32), and

an intrinsic safety barrier (16) located in the non-hazard zone (11, 26) and operably connected between the RF antenna (24, 32) and the controller (14, 44) adapted to limit electrical energy passing to the RF antenna (24, 32) allowing passage of low energy RF signals to the RF antenna and restricting passage of RF signals having

energy greater than a safe threshold energy level to the RF antenna;
characterized in that the RFID tag and the RF antenna (24, 32) are located in the hazard zone (12, 28) and the intrinsic safety barrier (16) is further adapted to allow transmission of the low energy RF signals carrying information between the controller (14, 44) and the RF antenna (24, 32) without losing the integrity of RF signals propagating through said intrinsic safety barrier, wherein the intrinsic safety barrier (16) comprises two sets of a plurality of diodes, the two sets connected in parallel between the controller (14, 44) and ground, one set having its respective plurality of diodes (72a, 74a, 76a) arranged in series with a forward bias in one direction, the other set having its respective plurality of diodes (72b, 74b, 76b) arranged in series with a forward bias in the opposite direction and wherein the sets of diodes are unabridged."

Claim 1 according to the 4th auxiliary request reads as follows:

"A system for controlling, from a non-hazard zone (11, 26), at least one of filling or dispense of a liquid to or from a container (18) in a hazard zone (12, 28), the system comprising:
a radio frequency identification (RFID) tag comprising an electrically programmable storage element (22) adapted to electrically store information;
a radio frequency (RF) antenna (24, 32) adapted to at least one of store information to and read information from the storage element (22);
a controller (14, 44), located in the non-hazard zone (11, 26) and in electrical communication with the radio frequency (RF) antenna (24, 32) adapted to

control the system based on communication between the storage element (22) and the radio frequency (RF) antenna (24, 32); and

an intrinsic safety barrier (16) located in the non-hazard zone (11, 26) and operably connected between the RF antenna (24, 32) and the controller (14, 44) adapted to limit electrical energy passing to the RF antenna (24, 32) allowing passage of low energy RF signals to the RF antenna and restricting passage of RF signals having energy greater than a safe threshold energy level to the RF antenna;

characterized in that the RFID tag and the RF antenna (24, 32) are located in the hazard zone (12, 28) and the intrinsic safety barrier (16) is further adapted to allow transmission of the low energy RF signals carrying information between the controller (14, 44) and the RF antenna (24, 32) without losing the integrity of RF signals propagating through said intrinsic safety barrier, wherein the intrinsic safety barrier (16) comprises at least three banks of diodes, each bank of diodes comprising two sets of a plurality of diodes, the two sets connected in parallel between the controller (14, 44) and ground, one set having its respective plurality of diodes (72a, 74a, 76a) arranged in series with a forward bias in one direction, the other set having its respective plurality of diodes (72b, 74b, 76b) arranged in series with a forward bias in the opposite direction."

Claim 1 according to the 5th auxiliary request reads as follows:

"A manufacturing system including a hazard zone (12, 28) and a non-hazard zone (11, 26), the system comprising:

a storage element (22), adapted to electrically store information;

a communication device (24, 32), adapted to store information to and read information from the storage element (22);

a controller (14, 44), located in the non-hazard zone (11, 26) and in electrical communication with the communication device (24, 32), adapted to control the system based on communication between the storage element (22) and the communication device (24, 32); and

an intrinsic safety barrier (16) located in the non-hazard zone (11, 26) and operably connected between the communication device (24, 32) and the controller (14, 44) adapted to limit electrical energy passing to the communication device (24, 32),

characterized in that the storage element (22) and the communication device (24, 32) are located in the hazard zone (12, 28) and intrinsic safety barrier (16) is adapted to allow transmission of a signal carrying information between the controller (14, 44) and the communication device (24, 32), wherein the intrinsic safety barrier (16) comprises two sets of a plurality of diodes, the two sets connected in parallel between the controller (14, 44) and ground, one set having its respective plurality of diodes (72a, 74a, 76a) arranged in series with a forward bias in one direction, the other set having its respective plurality of diodes (72b, 74b, 76b) arranged in series with a forward bias in the opposite direction and wherein the sets of diodes are unbridged."

Claim 1 according to the 6th auxiliary request reads as follows:

"A manufacturing system including a hazard zone (12, 28) and a non-hazard zone (11, 26), the system comprising:

a storage element (22), adapted to electrically store information;
a communication device (24, 32), adapted to store information to and read information from the storage element (22);
a controller (14, 44), located in the non-hazard zone (11, 26) and in electrical communication with the communication device (24, 32), adapted to control the system based on communication between the storage element (22) and the communication device (24, 32); and
an intrinsic safety barrier (16) located in the non-hazard zone (11, 26) and operably connected between the communication device (24, 32) and the controller (14, 44) adapted to limit electrical energy passing to the communication device (24, 32),
characterized in that the storage element (22) and the communication device (24, 32) are located in the hazard zone (12, 28) and intrinsic safety barrier (16) is adapted to allow transmission of the signal carrying information between the controller (14, 44) and the communication device (24, 32), wherein the intrinsic safety barrier (16) comprises at least three banks of diodes, each bank of diodes comprising two sets of a plurality of diodes, the two sets connected in parallel between the controller (14, 44) and ground, one set having its respective plurality of diodes (72a, 74a, 76a) arranged in series with a forward

bias in one direction, the other set having its respective plurality of diodes (72b, 74b, 76b) arranged in series with a forward bias in the opposite direction."

Claims 1 according to the 7th, 8th, 9th and 10th auxiliary requests filed with the statement of grounds of appeal differ from claims 1 of the main request and of the 1st, 3rd, and 4th auxiliary requests, respectively, only in that the phrase, "without losing the integrity of RF signals propagating through said intrinsic safety barrier" in the latter requests has been replaced by the following wording:

"the RF signals propagated through said intrinsic safety barrier communicable between the storage element 22 and the radio frequency antenna (24, 32)."

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

The interpretation of the language of claims 1 of the then main request and of the then 1st, 3rd and 4th auxiliary requests given by the examining division was not the interpretation intended by the applicant. Thus, in order to clarify the scope of protection and overcome the objection under Article 123(2) EPC, a new main request and new 1st, 3rd and 4th auxiliary requests were submitted to the Board's attention. An alternative amendment to these requests was also filed by way of 7th to 10th auxiliary requests.

As to the 3rd to 6th auxiliary requests, the feature *"the sets of diodes are unbridged"* did not constitute a disclaimer, but was a technical feature described in the original application. In fact, it was clear from

Figure 3 of the application that the sets of diodes were unbridged.

The examining division's starting point in the assessment of inventive step was the disclosure in D2, which indeed comprised some of the features of the present invention. However, D2 did not include a hazard zone and a non-hazard-zone, and an intrinsic safety barrier in the hazard zone controlling the low energy RF signal passing to the RF antenna in the hazard zone such that the integrity of those signals was maintained, *i. e.* the signals emitted by the RF antenna could be read by the ID tag.

Starting from D2, the examining division had erroneously assumed that it would be within the common general knowledge of one skilled in the art to make the following adaptations without involving any inventive thought:

- To adapt the liquid handling system described in D2 to include a hazard zone, a non-hazard zone and an intrinsic barrier;

- To adapt the intrinsic safety barrier such that only RF signals having low energy may be passed through the intrinsic safety barrier;

- To adapt the intrinsic safety barrier such that the integrity of the RF signals propagating through the safety barrier was not lost.

Taking D2 as the starting point, the skilled person might have recognized that if the liquid handling system described in this document were to be useful with explosive substances then making the equipment intrinsically safe would be desirable. However, this did not imply that the ability to create such a desired system would have been within the skilled person’s general knowledge. In fact, at the priority date of the present application, it had been generally accepted that RF technology could not be used with intrinsic safety barriers. Hence, the skilled person would have followed the generally accepted teaching in the relevant technical field and rejected the idea of passing RF signals through an intrinsic safety barrier to communicate with RFID tags located in a hazard zone.

On the other hand, if the assessment of inventive step was based on combining the teachings of D2 with one or more of D1, D3 and D5, the skilled person would also have not arrived at the present invention, because D1, D3 and D5 did not teach, either explicitly or implicitly, passing an RF signal across an intrinsic safety barrier.

If, notwithstanding the prejudice in the technical field of the invention, the skilled person had tried to make the system of D2 work with an intrinsic safety barrier, such skilled person would have done so by trying an intrinsic safety barrier of the type described in D1, D3 or D5, only to find that such intrinsic barrier was not suitable for RF signals.

To demonstrate that a barrier of the type described in D1, D3 or D5 would not work with the system known from D2, the appellant had conducted some experiments and submitted a declaration of Mr O'Dougherty summarising the results of such experiments. As concluded by Mr O'Dougherty, none of the intrinsic barriers shown in

D1, D3 and D5 permitted the RF test signal to propagate therethrough.

In summary, the cited prior art wold have given the skilled person no incentive to make the system disclosed in D2 intrinsically safe according to the teaching of the present invention. Hence, each of the main request and the 1st to 10th auxiliary requests involved an inventive step within the meaning of Article 56 EPC.

Reasons for the Decision

1. The appeal is admissible.

Main Request

2. Claim 1 of the main request is directed to a "*system for controlling, from a non-hazard zone (11, 26), at least one of filling or dispense of a liquid to or from a container (18) in a hazard zone (12, 28)*". The claimed system comprises the following features:

   a) a radio frequency identification (RFID) tag comprising an electrically programmable storage element adapted to electrically store information,

   b) a radio frequency (RF) antenna adapted to at least one of store information to and read information from the storage element,

   c) a controller, located in the non-hazard zone and in electrical communication with the radio frequency antenna adapted to control the system based on communication between the storage element and the radio frequency antenna,

d) an intrinsic safety barrier located in the non-hazard zone and operably connected between the RF antenna and the controller adapted to limit electrical energy passing to the RF antenna allowing passage of low energy RF signals to the RF antenna and restricting passage of RF signals having energy greater than a safe threshold energy level to the RF antenna,

e) the RFID tag and the RF antenna are located in the hazard zone,

f) the intrinsic safety barrier is further adapted to allow transmission of the low energy RF signals carrying information between the controller and the RF antenna without losing the integrity of RF signals propagating through said intrinsic safety barrier."

Article 123(2) EPC

3.1 The present application addresses essentially the problem of preventing the ignition of volatile substances located in a hazard zone when electrical equipment is also located in the same hazard zone.

As explained in paragraph [0005] of the published application, one *"method of preventing an explosion caused by ignition of the hazardous substances is to make the electrical equipment intrinsically safe. The concept of intrinsic safety in electric process control systems is known in the prior art. Intrinsic safety involves limiting the electrical energy at potential* *sources of ignition in electrical circuits (hot components and spark sources) to such low levels that even under abnormal (fault) conditions there is no possibility of the electrical energy igniting an explosive atmosphere".*

3.2 Therefore, an essential feature of the present invention is an *"intrinsic safety barrier"*, located in the non-hazard zone, which is connected between a controller, also located in the non-hazard zone, and an RF antenna, located in the hazard zone.

3.3 Claim 1 of the main request specifies the intrinsic safety barrier in the following terms:

i) it is adapted to limit electrical energy passing to the RF antenna (cf. feature d) in point 2. above),

ii) it allows passage of low energy RF signals to the RF antenna (cf. feature d)),

iii) it restricts passage of RF signals having energy greater than a safe threshold energy level to the RF antenna (cf. feature d)),

iv) it is adapted to allow transmission of the low energy RF signals carrying information between the controller and the RF antenna without losing the integrity of RF signals propagating through said intrinsic barrier (cf. feature f)).

Hence, claim 1 defines the intrinsic safety barrier in terms of the effects which it is supposed to achieve, namely limiting the energy that can reach the RF antenna without interfering with the normal operation of the antenna and the controller.

3.4 As to iv), the application as originally filed does not refer to the *"integrity of RF signals"*. It is thus appropriate to consider how *"integrity of RF signals"* should be interpreted in the context of the invention and, in particular, of claim 1.

4.1 The passages of the description cited by the appellant in support of the amendments made to claim 1 specify the intrinsic safety barrier in the following terms:

- The intrinsic safety barrier is supposed to limit energy entering the hazard zone (cf. [0007], [0008], [0009], [0020], [0024] and [0029]).

- The intrinsic safety barrier includes a plurality of forward conduction diodes connected in parallel between the controller and ground, typically arranged in a multiple redundancy configuration (cf. paragraph [0010]).

- The intrinsic safety barrier preferably further includes a fuse connected in series with the plurality of forward conduction diodes to prevent overloading the plurality of forward conduction diodes and to limit the amount of power passed into the hazard zone (cf. paragraph [0010]).

- A plurality of blocking capacitors may be connected in series with the controller and the antenna to block a DC component of the signal coming from the controller (cf. paragraph [0010]).

- Further, at least one resistor may be connected in series with the controller and the antenna to suppress transient voltage surges at the antenna (cf. paragraph [0010]).

- Under normal operating conditions, the low energy signal from the RF card is allowed to pass through the transmission line to the RF antenna with little voltage drop and very little attenuation (cf. in particular paragraph [0035], first sentence).

- However, if an abnormal (fault) condition develops in the electrical equipment in non-hazard zone 11 or 26 (e.g., a power surge), banks of diodes 72, 74, and 76 change their transfer characteristic and restrict the energy transferred to hazard zone 12 or 28 to a safe level (cf. in particular paragraph [0035], second sentence).

Other passages of the description specify some of the actual parameters of the components of the intrinsic safety barrier.

4.2 When interpreted in the light of the description, feature f) can only imply that the intrinsic safety barrier does not interfere with the normal operation of the control system and thus essentially expresses in different terms that the safety barrier limits electrical energy by allowing passage of low energy RF signals and restricting passage of RF signals when the latter go above a given threshold. Therefore, both features d) and f) specify the function of an intrinsic safety barrier with respect to low energy RF signals, which should pass essentially unaffected, and higher energy signals, which should be blocked.

4.3 The Board is thus satisfied that claim 1 does not contain subject-matter extending beyond the content of the application as originally filed (Article 123(2) EPC).

4.4 The Board understands that the 7th to 10th auxiliary requests were intended to overcome a possible Article 123(2) objection against feature f) and, in particular, against the expression *"without losing the integrity of RF signals propagating through said intrinsic safety barrier"*. As the Board interprets this wording essentially in the sense of the alternative expression filed by the appellant by way of the 7th to 10th auxiliary requests, the assessment of the inventive step of the subject-matter of the main request and of the 1st, 3th and 4th auxiliary requests applies equally to the 7th to 10th requests.

Article 56 EPC - main request and 7th auxiliary request

5.1 As pointed out in the decision under appeal and not contested by the appellant, the system for controlling at least one of filling or dispensing of a liquid to or from a container disclosed in D2 comprises the following features of the present invention:

- an RFID tag comprising an electrically programmable storage element adapted to store information (see D2, reference sign 42 in Figure 4 and paragraph 16 and feature a) of claim 1);

- an RF antenna (see reference sign 60 in Figure 4 of D2) adapted to store information to and read information from the storage element (cf. feature b);

- a controller (see reference sign 52 in Figure 4 of D2) in electrical communication with the RF antenna adapted to control the system based on communication between the storage element and the RF antenna (see particular paragraph 22 of D2).

5.2 The subject-matter of claim 1 differs from the system according to D2 in that it further comprises the following features:

- the filling or dispense of a liquid takes place in a hazard zone and is controlled from a non-hazard zone;

- an intrinsic safety barrier is located in the non-hazard zone and operably connected between the RF antenna and the controller,

- the intrinsic safety barrier is adapted to limit electrical energy passing to the RF antenna and restricting passage of RF signals having energy greater than a safe threshold level to the RF antenna, so as to allow transmission of the low energy RF signals carrying information between the controller and the RF antenna without losing the integrity of (low) RF signals propagating through said intrinsic safety barrier.

5.3 In the light of the differences between the claimed system and D2, a problem addressed by the present invention can be defined as adapting the system of D2 so that it can be used to control the filling and dispensing of hazardous liquids.

5.4 The appellant has acknowledged that at the priority data of the present application, a person skilled in the art would have been aware of intrinsically safe systems and would have understood that one method of preventing an explosion caused by the ignition of hazardous substances was to make the electrical equipment intrinsically safe. Thus, the skilled person might have recognized that if the liquid handling system described in D2 were to be useful with explosive substances then making the equipment intrinsically safe would be desirable.

However, the appellant has alleged that it was generally accepted at the priority date of the invention that RF technology could not be used with intrinsic safety barriers. Hence, it would not have been obvious to the skilled person starting from D2 to make all the adaptations which would have been required to arrive at the claimed system. In fact, as shown in the declaration made by Mr O'Dougherty, the skilled person, realizing that an RF signal could not pass through an intrinsic safety barrier, would have rejected the idea of combining an intrinsic safety barrier, as shown in D1, D3 or D5, with the system of D2.

6.1 D6 relates to a portable radio frequency identification system for use in an explosive environment (see claim 12). Such a system comprises a radio frequency reader/ writer device having, *inter alia*, circuitry with redundant overvoltage protection.

The device shown in Figure 2 of D6 comprises an antenna 50 electrically connected to the circuitry 18 for transmitting power signals to and receiving data from the transponder 22 (cf. Figure 6). As pointed out in paragraph [0020], the antenna is a coil for greater transmission and reception efficiency at carrier frequencies under 20 MHz. As to the radio frequencies considered for the invention claimed by the appellant, it is noted that according to paragraph [0034] of the published application *"the signal which propagates between the RF card and the RF antenna along the transmission line is typically a 13.56 MHz signal"*. According to D6, a pair of Zener diodes is connected to the output of the voltage regulator to provide overvoltage protection to the circuitry 18 in the event of the voltage regulator 69 failing (cf. paragraph [0025]). These *"zener diodes 74 provide an intrinsically safe operation in potentially explosive environments"* (D6, column 5, lines 24 to 26). In other words, the Zener diodes 74 constitute an intrinsic safety barrier which allows passage of low energy RF signals, but restricts the energy transferred to the hazard zone by providing overvoltage protection.

6.2 D6 essentially shows that it was known before the priority date of the present application to use RF technology in a hazardous zone and, in particular, to use an intrinsic safety barrier (*i.e.* Zener diodes) to limit electrical energy passing to an RF antenna located in a hazardous zone.

6.3 In the light of D6, the Board considers that the person skilled in the art would not have had any prejudice against using RF technology in a hazardous zone. Furthermore, from D1, D3 and D5 the skilled person would have known that electrical equipment operated in a hazardous zone had to be provided with an intrinsic safety barrier which limited the amount of energy entering such zone.

7.1 In item 4 of the declaration of Mr O'Dougherty, it is stated that it had been known before the priority date of the present application that the high capacitance of the Zener diode used to create the voltage limiting portion of the intrinsic barriers available at the time would act as a high-frequency filter and block the RFID communication. It is also pointed out that before arriving at the present invention it was not obvious how the problem could be solved. Tests showed that safety circuits according to D1 and D3, which were based on Zener diodes, did not work properly with RF signals because Zener diodes were too high in capacitance and acted as a high-frequency filter, thereby blocking the signals.

Mr O'Dougherty's declaration actually appears to confirm the teaching of document D5.

7.2 According to D5 (column 1, lines 36 to 42), Zener diodes used in known intrinsic safety barriers are normally in the non-conducting state. When the voltage increases above the critical level, the Zener diodes become conducting and thus present a low dynamic internal resistance. Although under normal operating conditions the Zener diodes of such safety barriers are in the non-conductive state, their effect cannot be neglected. In fact, the Zener diode's depletion layer has a relative large capacity between 100 pF to several hundred pF and, in combination with the impedance of the conductors and the input resistance of the diodes forms a low pass filter that limits the frequencies which can pass through the safety barrier.

D5, which addresses the problem of designing an intrinsic safety barrier which allows <u>a high transmission rate</u> between non-hazardous and hazardous zones, teaches essentially to use a number of low capacity Zener diodes or, if particularly low capacity is desirable, to use low capacity PN diodes (see D5, column 6, lines 10 to 35 and Figures 2 and 3).

7.3 In item 21. of Mr O'Dougherty's declaration it is specified that RF test signals did not propagate successfully through the circuits according to Figures 2 and 3 of D5. According to the declaration (see page 8, second paragraph), the diodes employed to build the circuits used in the tests had a capacitance of 50 pF.

With respect to Figure 2, it is observed in D5 (column 6, lines 28 to 35) that when a particularly low capacity of the circuit branch 11 is required then branch 11 can comprise only low capacity, forward biased shunt diodes 13 and 14. In this case, the required bias voltage is achieved by connecting in series a sufficient number of low capacity diodes 13 or 14, each having a bias voltage of 0.6 V. As specified in claim 16 of D5 such diodes have preferably a capacitance smaller than 5 pF, *i.e.* one order of magnitude smaller than the diodes used by Mr O'Dougherty to build a circuit according to Figures 2 and 3 of D5. Hence, it cannot be concluded from Mr O'Dougherty's declaration that all embodiments of a safety barrier according to Figures 2 and 3 of D5 would, in principle, block RF signals. On the contrary, it is evident that the low-pass behaviour of the safety barrier depends essentially on the diodes' characteristics and, in particular, on their capacitance. An intrinsic safety barrier as shown in Figures 2 and 3 and having low capacity diodes with a capacitance of 5 pF, as suggested in D5, would evidently have a higher cut-off frequency than the safety barrier on which the appellant relies.

7.4 In summary, the Board considers that before the priority date of the present application the skilled person did not have any prejudice against using RF technology in a hazardous zone or against the possibility of limiting the energy passing to an antenna located in a hazardous zone without compromising the RF signals.

In the light of the disclosure in D5, it appears also to have been known that the commonly used intrinsic safety barriers comprising Zener diodes were not suitable for high-frequency signals because of the intrinsic large capacity of Zener diodes.

However, as taught in D5, this limitation of the known intrinsic safety barriers could be easily overcome by using low capacity PN diodes connected in series to provide the required voltage protection.

7.5 In the light of the cited prior art and of general knowledge in the relevant technical field, the Board considers that the person skilled in the art would have arrived at the claimed invention simply by combining the teachings of D2 and D5. Hence, the subject-matter of claim 1 of the main request does not involve an inventive step within the meaning of Article 56 EPC.

7.6 The same conclusion holds for the 7th auxiliary request (see item 4.4 of the decision).

1st and 8th auxiliary requests

8.1 Claim 1 according to the 1st auxiliary request differs from claim 1 of the main request in that it further comprises the following features:

g) the intrinsic safety barrier includes a plurality of forward biased diodes connected in parallel between the controller and ground;

h) the intrinsic safety barrier further includes a plurality of DC blocking capacitors connected in series with the controller and the RF antenna.

8.2 The appellant has not provided any arguments as to why the features which distinguish claim 1 of the 1st auxiliary request, or of any of the 2nd to 10th auxiliary requests, from claim 1 of the main request should contribute to an inventive step.

8.3 Regarding feature g), the safety barrier shown in Figure 2 of D5 includes a plurality of forward biased diodes 13, 17 and 14, 16 connected in parallel between the input/output line 7 and ground. As pointed out in D5, column 4, lines 13 to 18, it is customary to build redundancy into safety barriers in order to increase their reliability.

8.4 As to feature h), the Board concurs with the examining division that DC blocking capacitors in series between an input and an output of an electronic device are well-known means for suppressing the DC component of a signal and thereby providing galvanic isolation, as specified in column 7, lines 40 to 49 of D5.

8.5 Considering also that, as pointed out in item 4.1 of the contested decision, features g) and h) address different problems (*i.e.* redundancy and galvanic isolation) and thus their combination does not produce any unexpected effect, the Board finds that the addition of these features to the subject-matter of claim 1 of the main request does not involve any inventive activity (Article 56 EPC).

8.6 The same conclusion holds for the 8th auxiliary request.

2nd auxiliary request

9.1 Claim 1 of the 2nd auxiliary request differs from claim 1 of the main request in that it further comprises the following feature:

- the controlling system is included in a manufacturing system.

9.2 As observed in item 4.2 of the contested decision, the above feature is disclosed in D2. In fact, the system for storing, dispensing and processing liquids according to Figure 1 comprises a filling system 12 and a processing system 14. As shown in Figure 2, the filling system 12 comprises a control unit. According to paragraph [0003], liquid handling systems as disclosed in D2 are required in certain manufacturing processes and thus are included in manufacturing systems.

9.3 Hence, the Board agrees with the examining division that the feature which distinguishes claim 1 of the 2nd auxiliary request from the main request cannot contribute to an inventive step (Article 56 EPC).

3rd and 9th auxiliary requests

10.1 Claim 1 according to the 3rd auxiliary request differs from claim 1 of the main request in that it further comprises the following features:

g') the intrinsic safety barrier comprises two sets of a plurality of diodes, the two sets connected in parallel between the controller and ground, one set having its respective plurality of diodes arranged in series with a forward bias in one direction, the other set having its respective plurality of diodes arranged in series with a forward bias in the opposite direction,

h') wherein the sets of diodes are unbridged.

10.2 As to feature h'), the appellant has submitted that it was clear from Figure 3 that the sets of diodes were unbridged. Thus, the phrase objected to by the examining division was a technical feature described in the application as filed.

10.3 The description of the present application does not refer to the fact that an intrinsic safety barrier according to the present invention comprises two sets of diodes as recited in feature g') and that such sets of diodes are unbridged (feature h')). On the other hand, Figure 3 shows a particular embodiment of an intrinsic safety barrier comprising three sets of diodes connected in series between the controller and ground and biased in one direction, and three similar sets of diodes biased in the opposite direction. Indeed, it can be inferred from this figure that the sets of diodes are unbridged. On the other hand, it could be argued that extracting such feature from Figure 3 and applying it to any intrinsic safety barrier comprising two sets of diodes as specified in feature g') could be regarded as an intermediate generalisation of the subject-matter disclosed in the original application and as such not admissible under Article 123(2) EPC.

In any case, the Board notes that the appellant has not explained why two unbridged sets of diodes should, as an intrinsic safety barrier, be preferred to the two bridged sets of diodes shown in Figures 2 and 3 of D5, or if and to what extent the functionalities of the corresponding safety barriers may differ. With reference to feature h'), the applicant had observed in the letter dated 18 May 2012 (page 5) that the "*two sets of diodes that are unbridged serve to control the voltage of the electrical signal passing through the intrinsic safety barrier so that it is at a safe level in the hazard zone*". This is also what the intrinsic safety barriers shown in Figures 2 and 3 of D5 were expected to do. Hence, the Board considers that the two sets of unbridged diodes according to feature h') constitute an obvious alternative to the circuits of Figures 2 and 3 of D5.

10.4 As to feature g'), Figure 3 of D5 shows an intrinsic safety barrier comprising two sets of a plurality of diodes, the two sets connected in parallel between a signal input/output line and ground, one set having its respective plurality of diodes arranged in series with a forward bias in one direction, the other set having its respective plurality of diodes arranged in series with a forward bias in the opposite direction.

10.5 Hence, the subject-matter of claim 1 according to the 3rd auxiliary request does not involve an inventive step within the meaning of Article 56 EPC.

10.6 The same conclusion holds for claim 1 according to the 9th auxiliary request.

4th and 10th auxiliary requests

11.1 Claim 1 according to the 4th auxiliary request differs from claim 1 of the main request in that:

i) the intrinsic safety barrier comprises at least three banks of diodes and,

g'') each bank of diodes is as specified in feature g') of claim 1 according to the third auxiliary request.

11.2 As to feature i), the Board agrees with the opinion of the examining division that the provision of multiple banks of diodes cannot contribute to the inventive step of the claimed subject-matter since it is obviously advantageous to add redundancy in the shunt-diodes of an intrinsic safety barrier limiting overvoltage of bipolar signals (cf. item 4.4 of the contested decision).

Hence, the subject-matter of claim 1 according to the 4th auxiliary request does not involve an inventive step within the meaning of Article 56 EPC.

11.3 The same conclusion holds for the 10th auxiliary request.

5th auxiliary request

12.1 The 5th auxiliary request corresponds to the same request considered in items 4.5 of the contested decision and differs from the 3rd auxiliary request addressed in the contested decision only in that it further comprises the following feature:

- the controlling system is included in a manufacturing system.

12.2 As pointed out above, this feature known from D2 cannot contribute to an inventive step (Article 56 EPC).

6th auxiliary request

13.1 The 6th auxiliary request corresponds to the same request considered in items 4.6 of the contested decision and differs from the 4th auxiliary request addressed in the same decision only in that it further comprises the following feature:

- the controlling system is included in a manufacturing system.

13.2 As pointed out above, this feature known from D2 cannot contribute to an inventive step (Article 56 EPC).

14. In summary, the Board comes to the conclusion that none of the appellant's requests can form a basis for granting a patent. Thus, the appeal has to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:	The Chairman:
I. Aperribay	R. Moufang

Decision electronically authenticated