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Datasheet for the decision of 18 July 2019

Case Number: T 1537/17 - 3.2.03

Application Number: 09275009.0

Publication Number: 2098682

IPC: E21B34/06, E21B23/06

Language of the proceedings: EN

Title of invention:
Electronic completion installation valve

Applicant:
Halliburton Manufacturing & Services Limited

Headword:

Relevant legal provisions:
EPC Art. 52(1), 54(1), 54(2), 56

Keyword:
Novelty - main request (yes)
Inventive step - main request (yes)

Decisions cited:

Catchword:

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Beschwerdekammern

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Case Number: T 1537/17 - 3.2.03

D E C I S I O N
of Technical Board of Appeal 3.2.03
of 18 July 2019

Appellant: (Applicant)	Halliburton Manufacturing & Services Limited Russell House, Block D Regent Park, Kingston Road Leatherhead KT22 7LU (GB)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 10 February 2017 refusing European patent application No. 09275009.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	G. Ashley
Members:	V. Bouyssy
	A. Jimenez

Summary of Facts and Submissions

I. European patent application No. 09275009.0 (in the following: "the application") relates to a tubing mounted completion assembly for running at an end of a completion string.

II. The examining division refused the application because the amended claims filed as the main and first auxiliary requests with letter dated 16 January 2017 lacked novelty and inventive step.

III. This decision was appealed by the applicant (in the following "the appellant").

IV. In the statement setting out the grounds of appeal, the appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the amended claims filed as the main request with letter dated 16 January 2017, alternatively on the basis of the amended claims filed as the first auxiliary request with letter dated 16 January 2017.

V. With the summons to oral proceedings, the Board sent a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA) indicating its preliminary opinion of the case. In this communication, the Board raised a new objection of lack of novelty against the main request, a new objection of lack of inventive step against the main and first auxiliary requests, and a new objection under Article 84 EPC against the main and first auxiliary requests.

VI. In response to the summons, with letter of 18 June 2019, the appellant filed a set of amended

claims as a new main request replacing the previous main request on file, and amended description pages.

VII. Oral proceedings before the Board were held on 18 July 2019.

VIII. Final requests

The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the set of amended claims filed as the main request with letter dated 18 June 2019, alternatively on the basis of the set of amended claims filed as the first auxiliary request with letter dated 16 January 2017.

IX. Claims of the appellant's main request

Independent apparatus claim 1 of the main request reads as follows (the feature numbering is introduced by the Board for ease of reference; compared with claim 1 of the application as originally filed, added passages are indicated in bold, deleted passages in strike-through):

(a) A tubing mounted completion assembly **(15)** for running at an end of a completion string **(10)**;
(b) the assembly **(15)** comprising a substantially tubular body for connection in a tubing string **(10)** below a production packer **(16)**,
(c) the assembly having a through bore **(40)** with a first inlet **(44)** and a first outlet **(48) each** coaxial with the tubing string **(10)**;
(d) a downhole electronic actuating mechanism **(32)**, **a battery arranged to provide a remote power supply to the electronic actuating mechanism**, a downhole hydraulic pump **(34)** and a hydraulically operated valve member **(30)**;

(e) wherein the actuating mechanism **(32)** operates the hydraulic pump **(34)** to ~~provide~~ **pump fluid through** at least one hydraulic control line **(56)** to control movement of the valve member **(30)** from a first position, where the **valve** member **(30)** is open and a through bore **(40)** is created between the inlet **(44)** and outlet **(48)** of the assembly, to a second position, where the valve **member (30)** seals the through bore **(40)**, and~~, finally,~~ back to the first position.

Dependent claims 2 to 6 define preferred embodiments of the completion assembly of claim 1.

Independent method claim 7 reads as follows (compared with claim 7 of the application as originally filed, added passages are indicated in bold):

A method of controlling fluid flow in a completion string, the method comprising the steps:

(a) locating a completion assembly **(15)** according to any one of claims 1 to 6 at an end of a tubing string **(10)**;

(b) running the tubing string **(10)** into the well bore **(20)** with the valve **member (30)** in the first position for fluid to flow in the inlet and out of the outlet as it fills the string;

(c) actuating the valve member **(30)** to move to the second position and setting the production packer **(16)** to thereby provide a downhole barrier; and

(d) actuating the valve **member (30)** back to the first position to allow produced fluids to flow in the inlet and out of the outlet up the string **(10)**.

Dependent claims 8 to 15 define preferred embodiments of the controlling method of claim 7.

X. Prior art

The following prior art documents were cited in the search report:

D1: EP 0 999 341 A2;
D2: US 2007/102164 A1;
D3: US 2003/051881 A1;
D4: WO 2007/049046 A1;
D5: US 2002/121373 A1;
D6: US 2004/020657 A1;
D7: US 6 364 023 B1;
D8: GB 2 270 707 A; and
D9: EP 2 022 933 A2.

Of these, D9 constitutes prior art under Article 54(3) EPC.

XI. The arguments of the appellant, insofar as relevant for the present decision, can be summarised as follows:

(a) Admissibility of the main request

The new main request is filed in direct reaction to the objections raised in the Board's communication under Article 15(1) RPBA.

(b) Main request - Article 123(2) EPC

The amendments to claims 1 and 7 are supported by the information in the application documents as originally filed. Support for the amendment of feature (c) can be found in figures 1 to 5 and 8. Support for the amendment of feature (e) can be found on page 14, lines 4 and 15. The amendment of feature (d) is based on the

teaching on page 13, lines 4 to 7 that a battery provides a remote power supply so that the electronic actuating mechanism is entirely independent of any control lines or electronic signalling from the surface of the well bore. Even though it follows from the paragraph bridging pages 13 and 14 that the actuation mechanism comprises a control module which monitors well pressure, temperature and time and that the module includes the battery as well as a logic processor pre-programmed to perform logical operations and calculations relating to the measured signals, it is apparent that these further features are not essential for remotely powering the electronic actuating mechanism. Consequently, the amendment of feature (d) does not amount to an unallowable intermediate generalisation of this specific disclosure.

(c) Main request - Novelty

The examining division erred in deciding that claim 1 lacked novelty over D1. In fact, D1 is directed to a series of spaced-apart sliding sleeve valves (36, 38, 40) which are used, in conjunction with packers (30, 32, 34), to isolate selectively and draw fluid from certain areas of an already-completed wellbore. Thus, D1 relates to valves that are used to control the flow of fluid in a radial direction from the wellbore, which is external to the tubing string, to the inside of the tubing string. This in contrast to the requirement of claim 1 for the valve member to be configured to seal the through bore of the tubing string itself (features (c) and (e) of claim 1).

The subject-matter of claim 1 is also novel over D3. The downhole device of D3 receives power along tubing string 26, but not from a battery contained in the

completion assembly mounted at the end of a completion string (feature (d)). Furthermore, the downhole device in D3 is not suitable to be run "at an end of a completion string" (feature (a)) and is not suitable "for connection in a tubing string below a production packer" (feature (b)), as this would render it non-functional for the following reasons. It is stated in paragraph 32 of D3 that in order to function a section of tubing string 26 is isolated between insulating tubing joint 40 and lower induction choke 42, in order to provide a power and communication path to the downhole device. As noted in paragraph 36, packer 49 is placed below lower induction choke 42 and serves to electrically connect metal tubing string 26 to metal casing 24, which would typically not allow electrical signals to be transmitted or received up and down borehole 11 using tubing string 26 and casing 24. This is only possible when the section of tubing string 26 above the packer 49 is isolated between insulating tubing joint 40 and lower induction choke 42.

(d) Main request - Inventive step

Contrary to the examining division's view, D1 is an unsuitable starting point for arriving at the claimed invention. To suggest that the skilled person would replace a valve of D1 which is intended to regulate radial fluid flow between the external wellbore and the interior of the tubing string with a valve intended to regulate co-axial fluid flow entirely within the tubing string can only be as a result of a hindsight approach to the assessment of inventive step. The skilled person would have no motivation to perform such a modification, because it would negate the purpose of the valves of Dl.

Starting from D3, it is unlikely that an obvious modification exists that would permit power transmission in the tubing string 26 below packer 49. Additionally, any change to the system of D3 to provide a remote downhole power supply would be entirely contradictory to the teaching and purpose of this document, and as such it would not be obvious to include such a feature when starting from D3.

D5 discloses, in figure 4, a downhole system to pressure test a tubing in a well, using an intelligent remote implementation system (IRIS) 129 to control opening and closing of a spring-biased flapper valve 38 by coupling differential pressure across a mandrel 44 via control lines coupled to an hydrostatic chamber 138 and an atmospheric chamber 140. IRIS 29 forms an electronic control system but not an electronic mechanism for actually moving the valve member 38. The subject-matter of claim 1 differs from the assembly in figure 4 of D5 in that it comprises a downhole electronic actuating mechanism, a downhole hydraulic pump, a hydraulically operated valve member and a battery arranged to provide a remote power supply to the electronic actuating mechanism (feature (d)).

In Figure 4 of D5, the motive power for moving mandrel 44 against the spring bias is provided by energy stored in hydrostatic chamber 138. The capability of chamber 138 to effect movement of mandrel 44 is significantly limited due to the dissipative effect of releasing the stored pressure, which will reduce the pressure in chamber 138 and limit the ability to overcome the spring bias on successive opening cycles for pressure testing. For this reason, D5 contemplates only a limited number of opening cycles. The distinguishing features of claim 1 have the effect that the valve

member can be reliably opened and closed in less limited fashion on demand and thus that a large number of pressure cycles are possible. Thus, the objective technical problem is that of improving operational capability.

The claimed solution to this problem is not rendered obvious by the cited prior art documents.

It is taught in D1 that pump 62 shown in figure 4 "could be a motorized rotary or axial pump, a hydraulic accumulator, a device which utilizes a pressure differential between hydrostatic pressure and atmospheric pressure to produce hydraulic pressure" (paragraph 94) and that the electricity to operate the pump 62 "may be supplied by a battery installed as a part of the tubing string or conveyed separately therein" (paragraph 96). However, the skilled person seeking to solve the objective problem has no reason to consider this teaching because D1 is not concerned with valves used as plugs in the tubing string to seal the tubing bore, let alone with the problem of pressure testing against such valves.

D3 discloses a downhole hydraulic system (70) for operating an emergency shut-off valve (74), the system comprising a hydraulic pump (76), an electric motor (78) and a modem (89) electrically connected to a controller (90) for controlling the operation of the motor. Again, the skilled person facing the afore mentioned problem has no reason to consider this teaching. Further, the downhole device of D3 receives power from a power source (44) which is disposed outside of the borehole (11) at the surface (12), and not from a downhole battery, and D3 teaches that the limited lifetime of batteries makes their use less than

ideal in an operating petroleum well (paragraph 11). Therefore, even if the skilled person were to consider combining the teaching of D5 with that of D3, they would not arrive at the claimed solution in an obvious manner.

Reasons for the Decision

1. Admissibility of the main request

1.1 Claim 1 of the current main request differs from that of the main request submitted with the statement of grounds of appeal in that

- it comprises the further limitation that the completion assembly comprises a battery arranged to provide a remote power supply to the electronic actuating mechanism (feature (d)), and
- in feature (e), the expression "wherein the actuating mechanism (32) operates the hydraulic pump (34) to provide at least one hydraulic control line to control movement of the valve member " has been recast into "wherein the actuating mechanism (32) operates the hydraulic pump (34) to pump fluid through at least one hydraulic control line to control movement of the valve member".

1.2 These amendments are in response to objections of lack of clarity, lack of novelty and lack of inventive step which were raised for the first time in the Board's communication pursuant to Article 15(1) RPBA. They clearly overcome all outstanding objections without introducing any new issues.

1.3 For these reasons, the Board decides to admit the new main request into the proceedings and to consider it,

in accordance with Rule 137(3) EPC (which is applicable by virtue of Rule 100(1) EPC) and Article 13(1) RPBA.

2. Amendments

2.1 The Board is satisfied that the amendments to the claims according the main request meet the requirements of Article 123(2) EPC.

2.2 Claim 1 differs from independent claim 1 as originally filed - apart from minor editorial amendments and the insertion of reference signs - in that

- feature (c) has been amended to recite that "each" of the first inlet and first outlet of the through bore is coaxial with the tubing string,
- feature (d) has been amended to require "a battery arranged to provide a remote power supply to the electronic actuating mechanism", and
- feature (e) has been amended to require that the actuating mechanism operates the hydraulic pump "to pump fluid through" the hydraulic control line to control movement of the valve member.

2.3 These amendments are supported by the information in the application documents as originally filed, as indicated by the appellant.

2.4 Claim 7 corresponds to independent claim 7 as originally filed, apart from the insertion of reference signs and amendments of editorial nature only.

3. Article 84 EPC

3.1 The amended claims are clear and concise and supported by the description.

3.2 Dependent method claim 10 defines the step of "pulling the string so that the monitored hydrostatic pressure reduces to be below the predetermined value and thereby resets the timer". Contrary to the Board's preliminary view in the communication pursuant to Article 15(1) RPBA, this additional step is not in contradiction with step (c) of independent method claim 7, which requires that the production packer is set. In fact, it is apparent that pulling the string does not require unsetting the packer. The string is long and has inherent capacity for flexure and elongation when pulled, whilst reducing the hydrostatic pressure, without the need to unset the packer.

4. Main request - Novelty

4.1 In the decision under appeal, the examining division objected that the subject-matter of claim 1 lacked novelty in light of D1.

4.2 However, the Board shares the appellant's view that D1 fails to disclose features (c) and (e) of claim 1:

4.2.1 D1 is concerned with the provision of a method and an apparatus for controlling fluid flow within a wellbore which permits an operator to produce or inject fluid from or into a selected portion of the formation intersected by the well (paragraph 6). In broad terms, D1 teaches that this is achieved by providing a tubing string including a longitudinally spaced apart series of sealing devices, such as packers, which can be selectively engaged with the wellbore to restrict fluid flow between the tubing string and a selected portion of the formation (paragraph 9). In a preferred embodiment, flow control devices are alternated with the sealing devices along the tubing string to provide

selective fluid communication between the tubing string and portions of the formation (paragraph 11). The sealing devices and/or flow control devices may be actuated by remote control or by intervening into the well, e.g. by conveying a pump into the well (paragraph 12).

4.2.2 In the preferred embodiments of the apparatus shown in figures 1 to 8 of D1, the tubing string 28 comprises longitudinally spaced apart series of sealing devices 30, 32 and 34 in the form of packers and a longitudinally spaced apart series of flow control devices 36, 38 and 40. As stated in paragraph 83 of D1, the flow control devices are illustrated as sliding sleeve-type valves but they may instead be downhole chokes, pressure operated valves or remotely controllable valves. In any event, each of the valves 36, 38, 40 can be opened and closed independently and selectively to permit or prevent fluid flow from portions of the formation into the tubing string 28 and vice versa (paragraph 84). Thus, the valves serve as circulation valves to control the radial flow of fluid from the annulus into the tubing string, and vice versa (see also column 10, lines 33 to 35 and column 26, line 6), but not as plugs in the tubing string to seal the tubing bore, as required by feature (e). In fact, the distal end of the tubing string is closed by a bull plug 42.

4.2.3 Figure 18 of D1 shows another preferred embodiment of the apparatus, where it is depicted interconnected as a part of a tubular string 304 installed in a wellbore and including a tool or item of equipment 302, such as a valve, choke or other flow control device (paragraphs 151 and 152). It cannot be derived from D1 that the valve 302 serves as a plug to seal the through bore of

the string 304. Instead, in the context of D1, it is apparent that the valve 302 serves to control the radial flow of fluid between the annulus and the interior of the string 304, in the same manner as the circulation valves illustrated in figures 1 to 8.

4.3 The Board is also satisfied that the claimed subject-matter is not anticipated by the other prior art documents cited by the examining division.

4.4 In particular, the subject-matter of claim 1 is novel in light of D3:

4.4.1 D3 discloses, in figures 1 and 3, a downhole valve assembly (hydraulic system 70) comprising a substantially tubular body (26) for connection in a tubing string above a production packer (49) and having a through bore with a first inlet and a first outlet each coaxial with the tubing string. The assembly comprises a downhole electronic actuating mechanism (modem 89, controller 90), a downhole hydraulic pump (76) and a hydraulically operated valve member (74), wherein the actuating mechanism operates the hydraulic pump to pressurise an hydraulic control line to control movement of a valve member (emergency shut-off valve 74) from a first position, where the valve member is open and a through bore is created between the inlet and outlet of the assembly, to a second position, where the valve member (74) seals the through bore, and back to the first position (paragraphs 41 to 43).

4.4.2 However, it cannot be derived from D3 that the downhole valve assembly is intended or suitable "for running at an end of a tubing string" (feature (a)) and "for connection in a tubing string below a production packer" (feature (b)). In order to function, the

downhole valve assembly of D3 must be positioned above production packer 49 because the electronic actuating mechanism receives power from the surface of the well bore, via the tubing string 26, and packer 49 serves to electrically connect tubing string 26 to metal casing 24 (paragraphs 32 and 36). Thus, the electronic actuating mechanism does not receive power from a battery (feature (d)). In fact, D3 teaches away from using batteries (paragraph 11).

4.5 In conclusion, in light of the prior art cited by the examining division, the subject-matter of claim 1 is new in the sense of Articles 52(1) and 54(1)(2) EPC.

5. Main request - Inventive step

5.1 In the decision under appeal, the examining division concluded that the subject-matter of method claim 7 lacked an inventive step in view of D1 in combination with D2. In particular, the examination division argued essentially that the method defined in claim 7 differed from that disclosed in D1 by steps (b) to (d), that the objective technical problem was how to provide a tubing seal and that the claimed solution to this problem was rendered obvious by the teaching of D2.

5.2 The Board shares the appellant's view that this objection is not persuasive.

5.2.1 D1 does not form a realistic starting point for the assessment of inventive step because, contrary to the claimed invention, it is not concerned with the opening and closing of the tubing bore during run-in and completion of a tubing string (page 1, paragraphs 1 and 2 of the application as filed), let alone with downhole plugs or valves designed to open and close the

tubing bore during run-in and completion and thus allow pressure testing of the tubing string and setting of a packer (page 1, paragraph 3 to page 4, paragraph 2 of the application as filed).

5.2.2 Even if the skilled person were to start from D1, they would not arrive at the subject-matter of claim 7 in an obvious manner. D1 fails to disclose a completion assembly with features (c) and (e) of claim 1 and thus it fails to disclose step (a) of claim 7. The subject-matter of claim 7 therefore differs from D1 by steps (a) to (d). The problem objectively solved by these distinguishing features can be seen as how to provide a method for performing a completion run in a wellbore wherein the tubing string bore can be opened and closed reliably remotely from the surface. The Board is not persuaded that the skilled person, in the expectation of solving this problem, could and indeed would modify the method of D1 in view of the teaching of D2 so as to arrive at the claimed invention. In fact, D2 is concerned with a circulation valve (44) with lateral flow passages (48), which can be automatically actuated from an open position, wherein fluid can flow radially from the annulus (90) into the tubing bore (to fill up the tubing string 30 during run-in) or from the tubing bore out into the annulus (circulation), to a closed position allowing to set the packer (38) or other hydraulically-actuated tools. Thus, D2 could not lead in any way to a valve member that creates a seal in the tubing bore, as required by feature (e) of claim 1 and thus by feature (a) of claim 7.

5.3 D5 forms a more realistic starting point than D1 for the assessment of inventive step. In fact, among the prior art documents cited by the examining division in the examination proceedings, D5 forms the most

promising starting point because it relates to a downhole electronically-controlled valve that can be opened and closed remotely from the surface to pressure test a production tubing string and to set the packer and that is opened during run-in (see paragraph 43 of D5), as is the case with the preferred embodiment of the claimed invention (see figures 1 to 3 of the application).

5.4 D5 discloses, in figure 4, a remotely controlled downhole valve assembly (30") for running at an end of a tubing string (10), the assembly comprising a substantially tubular body (housing 32) for connection in the tubing string below a production packer (66) and having a through bore (34) with a first inlet and a first outlet each coaxial with the tubing string. The assembly comprises a downhole electronic actuating mechanism, a battery to provide a remote power supply to the electronic actuating mechanism and downhole means relying on differential pressure to produce hydraulic pressure and a hydraulically operated valve member (see IRIS 129; electronics 134; battery 136; hydrostatic chamber 138; atmospheric chamber 140; means/valve to vent fluid from chamber 138 to chamber 140 using the pressure differential; flapper valve 38). The actuating mechanism operates the differential pressure operated means to provide fluid flow in a hydraulic control line (142) to control movement of the valve member (38) from a first position, where the valve member is open and a through bore is created between the inlet and outlet of the assembly, to a second position, where the valve member seals the through bore, and back to the first position (paragraphs 41 and 44).

5.5 The subject-matter of claim 1 differs from this valve assembly disclosed in D5 in that it comprises a downhole hydraulic pump (feature (d)), whereby the electronic actuating mechanism operates the hydraulic pump to pump fluid through at least one hydraulic control line to control movement of the valve member (feature (e)).

5.6 Thanks to these distinguishing features the valve member can be reliably actuated, even after a large number of pressure cycles. In fact, a drawback of the differential pressure operated means disclosed in figure 4 of D5 is that, after a limited number of pressure cycles, the pressure differential between the hydrostatic and atmospheric chambers can be too low to actuate the valve member. For this reason, D5 contemplates only a limited number of pressure cycles before locking the valve in the open position (two cycles in paragraphs 43 and 44).

5.7 Thus, starting from D5, the problem objectively solved by the distinguishing feature can be formulated as how to improve operational capability.

5.8 The Board shares the view of the appellant that the claimed solution to this problem is not part of the common general knowledge of the skilled person and is neither disclosed nor suggested in the cited prior art documents.

5.9 D1 discloses, in figure 4, an apparatus for controlling fluid flow within a wellbore, wherein the circulation valves 36, 38 and 40 are selectively activated by means of a pump 62 which is for instance a motorised rotary or axial pump or a device which utilizes a pressure differential between hydrostatic pressure and

atmospheric pressure to produce hydraulic pressure (paragraph 94), and electricity to operate the pump is supplied by an electric line 54b extending to the surface or by a battery installed as part of the tubing string (paragraph 96). The Board can see no reason why the skilled person facing the objective problem would consider this specific teaching of D1, in particular because D1 does not relate to downhole plugs/valves designed to open and close the tubing bore during run-in and completion and thus allow pressure testing of the tubing string. D1 does not teach any particular advantage in using a motorised rotary or axial pump instead of differential pressure operated means to produce hydraulic pressure.

5.10 Even though D3 discloses a hydraulic system (70) for operating a downhole shut-off valve (74) which comprises the distinguishing features of claim 1 (see point 4.4.1 above), the Board can see no reason why the skilled person would consider this teaching since D3 does not address the problem to be solved. Further, the electronic actuating mechanism of D3 receives power from the surface, not from a battery (feature (d)), and D3 expressly teaches away from using batteries (paragraph 11). Therefore, even if the skilled person were to consider combining the teaching of D5 with that of D3, they would inevitably consider supplying power to the electronic actuating mechanism from the surface. In doing so they would not arrive at distinguishing feature (d).

5.11 In conclusion, with regard to the prior art cited by the examining division, the subject-matter of claim 1 involves an inventive step in the sense of Articles 52(1) and 56 EPC.

6. The subject-matter of independent claim 7 is also new and non-obvious, because it concerns a method making use of the completion assembly defined in claim 1.

7. The description has been brought into conformity with the amended claims.

8. The Board comes to the conclusion that the application documents according to the main request meet the requirements of the EPC.

9. Under these circumstances, there is no need to consider the first auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division with the order to grant a patent in the following version:
   - claims 1 to 15 filed as main request with letter dated 18 June 2019;
   - description pages 1, 3 and 8 to 16 as originally filed, description pages 2, 6 and 7 filed with letter dated 7 October 2013, and description pages 4 and 5 filed with letter dated 18 June 2019; and
   - drawing sheets 1/2 and 2/2 filed with letter dated 14 May 2009.

The Registrar: The Chairman:

C. Spira G. Ashley

Decision electronically authenticated