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Datasheet for the decision of 12 December 2025

Case Number: T 0294/24 - 3.4.01

Application Number: 20168985.8

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IPC: G21B3/00

Language of the proceedings: EN

Title of invention:
METHOD AND APPARATUS FOR ENERGY CONVERSION

Applicant:
Cill AB

Headword:
Energy conversion / Cill

Relevant legal provisions:
EPC Art. 52(1), 57, 83
EPC R. 42(1)(e), 63(1), 63(2)

Keyword:
Main request and both auxiliary claim requests - sufficiency of disclosure (no) - industrial applicability (no) - way of carrying out the invention (no) - no search (justified)

Decisions cited:
T 0541/96, T 1242/04, T 1164/11, T 1485/17

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Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0

Case Number: T 0294/24 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 12 December 2025

Appellant: (Applicant)	Cill AB P.O. Box 9 149 21 Nynäshamn (SE)
Representative:	Noréns Patentbyrå AB Box 10198 100 55 Stockholm (SE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 9 October 2023 refusing European patent application No. 20168985.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair	P. Scriven
Members:	T. Petelski
	D. Rogers

Summary of Facts and Submissions

I. The Search Division took the view that the invention as defined in the claims as originally filed was not sufficiently disclosed, in the application, for it to be carried out by a person skilled in the art; and also, that the invention was not industrially applicable. This had not been changed by the applicant's explanations of the subject-matter to be searched (in response to a communication under Rule 63(1) EPC). Hence, the Search Division issued a declaration under Rule 63 EPC, containing reasons why the application did not comply with the provisions of the EPC (Articles 52(1), 57, 83, and Rule 42(1)(e) EPC) to such an extent that it was possible to carry out a meaningful search.

II. The Examining Division maintained this view, regardless of amendments to the claims, and, without performing an "additional" search, decided to refuse the application for insufficient disclosure (Article 83 and Rule 42(1)(e) EPC). In its decision, the Examining Division stated that performing a meaningful search of the claims was neither possible nor practicable.

III. The decision was appealed, and the appellant requested that the decision be set aside and that:

(a) a search be carried out for the subject-matter of the claims as originally filed, and that the application be examined (main request);

(b) a search be carried out for claims 7 and 19 as originally filed, in combination with the rest of the claims (including claim 1), and that the application be examined (first auxiliary request);

(c) a search be carried out for the subject-matter of a set of claims filed with the grounds of appeal, and that the application be examined (second auxiliary request);

(d) a search be conducted on the subject-matter of a further set of claims filed with the grounds of appeal, and that the application be examined (third auxiliary request).

IV. The appellant did not request oral proceedings.

V. In a communication pursuant to Rule 100(2) EPC, the appellant was informed of the Board's preliminary opinion, according to which the invention as described in the application and defined in any of the claim requests could not be carried out, contrary to the requirement of Article 83 EPC. Furthermore, the application did not contain a credible way of carrying out the invention, contrary to the requirement of Rule 42(1)(e) EPC, and was not industrially applicable, contrary to the requirement of Articles 52(1) and 57 EPC. Considering these problems, the Board could not find fault in the decisions of the Search and Examining Divisions, under Rules 63(1) and (2) EPC, not to conduct a search or an "additional" search.

VI. In two further replies, both of the same date, the appellant commented on the Board's preliminary opinion and asked that the Board review its opinion based on these comments. They also requested "to be given the right to bring forward additional experimental results by April 30, 2026."

VII. In their submissions, the appellant referred to the following documents, of which D1 - D5 were introduced during examination proceedings (see point X of the contested decision) and D6 - D8 were annexed to the grounds of appeal.

D1: Arata et al.: "Production of Helium and Energy in the "Solid Fusion""; Proceedings of the ICCF 15 Conference; pages 72 - 81; (2009)

D2: Dmitriyeva et al.: "Mechanisms for Heat Generation during Deuterium and Hydrogen Loading of Palladium Nanostructures"; Journal of Condensed Matter Nuclear Science 8; pages 29 - 36; (2012)

D3: Liaw et al.: "Helium Analysis of Palladium Electrodes after Molten Salt Electrolysis"; Fusion Technology, 23(1), pages 92 - 97 (1993)

D4: Miles et al.: "Anomalous Effects in Deuterated Systems"; Naval Research Air Warfare Centre Weapons Division Technical Publication 8302 (1996)

D5: Burrow: "Correlation of the magnetic and mechanical properties of steel"; Bulletin of the Bureau of Standards, Vol. 13, pages 173 - 210 (1916)

D6: "A method for Conversion of Energy", a Power-Point Presentation, which the appellant states to have shown during oral proceedings before the Examining Division

D7: US Invention Registration Number H446; 1 March 1988

D8: Ad'yasevich, Fomenko: "Analysis of investigations of the reaction D(d,p)T with polarized deuterons"; Yadernaya Fizika (Russia), (1969), of which the appellant only submitted the reference data, but not the text.

VIII. Document D9 was introduced by the Board.

D9: Berlinguette et al.: "Revisiting the cold case of cold fusion"; Nature, Vol.570, pages 45 - 51 (2019)

IX. Claim 1 as originally filed (main request) reads:

Method for converting nuclear energy by fusing deuterium or tritium nuclei, which method comprises the initial step of providing a first hydrogen atom, in turn comprising a first deuterium or tritium nucleus and a first electron, and a second hydrogen atom, in turn comprising a second deuterium or tritium nucleus and a second electron, which method further comprises the following steps:

a) bringing the first nucleus and the second nucleus together to a distance between the first and second nucleus of at the most 7 Å;

b) applying a first magnetic field (H) such that a resulting total magnetic field (B) is arranged to align a first spin of said first nucleus in relation to a second spin of said second nucleus so that a respective spin axis of said first and second spins are anti parallel and directed either towards each other or away from each other and so that said first and second spins are projected on a common line between the first and second nuclei, which common line is parallel or anti-parallel to the total magnetic field (B);

c) ionizing said first hydrogen atom, or modifying the electron orbit of said first electron such that a spatial distribution for the first electron is such that the probability for the first electron to exist in a region between the first and second nuclei along the common line is smaller than in a spherically symmetric spatial distribution;

d) ionizing said second hydrogen atom, or modifying the electron orbit of said second electron such that a spatial distribution for the second electron is such that the probability for the second electron to exist in a region between the first and second nuclei along the common line is

smaller than in a spherically symmetric spatial distribution,

wherein steps a)-d) may be performed in any order but so that the first and second nuclei are provided at said distance, with said spin orientation and said ionized or electron orbit modified state, at one and the same time.

X. The wording of method claims 2 to 36, which are dependent on claim 1, and of system claim 37, which is defined in correspondence with method claim 1, is not relevant for this decision.

XI. In the auxiliary claim requests, method claim 1 is the only independent claim. It differs from claim 1 as originally filed by the addition of further method steps, the content of which is also not relevant for this decision.

Reasons for the Decision

Background on nuclear fusion

1. The application is about "cold fusion", also known as "low energy nuclear reaction" (LENR).

2. Nuclear fusion, in particular of the hydrogen isotopes deuterium or tritium, is difficult to achieve on Earth

with a significant probability, because the electrostatic repulsion between atomic nuclei opposes their close approach. In order for the attractive, but short-range, (residual) strong force to take over, the nuclei have to overcome the repulsion in form of the Coulomb barrier, until within a distance of about 1 femtometre (1×10^{-15} m) of each other. Overcoming the Coulomb barrier (about 100 keV) would require the particles to have kinetic energies that are only reached at temperatures of more than 1 billion Kelvin (1×10^{9} K). The Coulomb barrier need not be overcome completely, however, as there is a certain probability for a particle to tunnel through it. The tunnelling probability depends heavily on the width of the barrier. For temperatures above 10 million Kelvin (100×10^{6} K, corresponding to particle energies of a few keV), and under high pressure (high particle density), such as within stars, the barrier becomes sufficiently narrow for the tunnelling probability to assume non-negligible values, such that fusion occurs at noticeable rates. In hot fusion reactors, the larger particle distances of around 200 nanometres (200×10^{-9} m) require temperatures of more than 100 million Kelvin (100×10^{6} K) to ensure a sufficiently high tunnelling probability for fusion to occur at a rate that produces more energy than is supplied to the system.

3. At (comparatively) low temperatures, such as room temperature (293 K), the particles' kinetic energies are lower than the Coulomb barrier to an extent that, from the particles' perspective, the barrier appears much higher and, more importantly, also much wider. The increased width greatly reduces the probability of quantum tunnelling, which drops exponentially with particle energy (as was originally determined by Gamow

and Sommerfeld), by many orders of magnitude down to a completely negligible amount.

4. It is known that the Coulomb barrier can be lowered (and narrowed); for example, by trapping the atoms within a metal crystal, which brings them closely together for extended periods of time. The presence of lattice electrons between the nuclei weakens the repulsion between the positively charged nuclei, an effect known as "screening". However, the inter-nuclei distances in a crystal lattice are still far too large (about ten times that in the core of the sun) - on the order of several Angstroms (1Å = 10^{-10} m) - and the screening effect, as it is currently understood, is far too weak - on the order of hundreds of eV - for the Coulomb barrier to be lowered to an extent required to produce a yield that would generate more energy than is required to run the system.

5. There seem to be two main problems associated with cold fusion.

(a) Firstly, there is no widely-accepted scientific theory that would explain how the Coulomb barrier could be lowered or narrowed far enough to enable a sufficiently high probability of fusion between particles at low temperatures to be of industrial use. A commercial use would require that the usable energy output surpass the total energy input.

(b) Secondly, although there have been numerous experiments during the last three decades that show anomalous results (as in D1 to D4), these have proven difficult or impossible for other groups to replicate. In addition, the majority of the scientific community has not (yet) accepted the

interpretation of the results as necessarily involving more than isolated events (with an impractically low probability) of cold fusion. One reason for this lack of acceptance is that the amount of excess heat does not exceed the energy that is input into the system by a large enough margin to exclude other explanations of the results. Similarly, the amounts of fusion products that have been measured, such as helium particles or neutrons, are not high enough unequivocally to prove that fusion occurred, and rule out other possible sources (see D9).

Content of the application

6. The application presents an explanation of how the problems of cold fusion could be overcome.

7. A variety of generally recognized scientific theories is mentioned, which the application interprets and combines in new and unusual ways. According to the application, such combinations of well-established theories led to the conclusion that electrostatic repulsion could be disabled by a neutron, because no electromagnetic interaction could propagate through it. Hence, when aligning two deuterium nuclei on a common axis, such that the neutrons faced each other and the protons faced away from each other, there was no more Coulomb barrier that impeded fusion. In practice, deuterium nuclei trapped in a crystal lattice could be aligned by using a magnetic field to orient their magnetic moments. However, as the nuclei could only be aligned at a small angle to the axis of the magnetic field, their relative alignment was not perfectly anti-parallel. Accordingly, a low but easily surmountable

Coulomb barrier still remained ([0078] to [0112] and [0119] of the published application).

8. The application emphasises that the prevalent channel in this type of cold fusion reaction was the direct fusion of two deuterium nuclei to helium 4 (see formula (48) in paragraph [0263] of the published application), which was different from the channels prevalent in hot fusion ((46) combined with (47a), (47b), (47c) in paragraphs [0261] and [0262]).

The appellant's arguments

9. In essence, the appellant argued that a complete theory that explained all aspects of nuclear physics did not exist. Rather, a set of semi-empirical theories was used. Therefore, there was no theory that could accurately explain the mechanism of cold fusion that took place in the invention. It was importantly, however, that the invention was not in conflict with any of the generally accepted scientific theories, and the empirical evidence in the form of numerous measurement results was unambiguous in that cold fusion reactions were taking place. Hence, the invention merited the grant of a patent.

10. In the following, the most relevant of the appellant's arguments are summarized.

11. The appellant pointed out that the concept of the Coulomb barrier was based on a point-particle model that neglected the internal structure of the neutrons and protons. Such a model could not be extrapolated to the present invention, in which closely spaced deuterons were arranged on an axis by an external

magnetic field. The disabling of the electrostatic repulsion, or its neutralization by attractive nuclear forces, was a recognized concept in the physics of "nuclear matter".

12. The arrangement of two deuterons on an axis, caused by an external magnetic field, ensured that the reaction channel, in which two deuterium nuclei directly merged to form a helium-4 nucleus, under the emission of a high-energy photon (channel (48) in the application), occurred with a high probability. This reaction channel was consistent with widely accepted theories of nuclear physics, a fact that also followed from D3.

13. The appellant also explained why many experiments had problems in reproducing cold fusion. Often, such experiments used macroscopic palladium samples. During the process of loading the samples with deuterium, the initial paramagnetism of these samples turned to diamagnetism, thereby destroying the magnetic field necessary for the spin alignment of the deuterium nuclei. This problem could be avoided by using palladium nano-particles.

14. D1, D2, and D4 all used palladium nano-particles. The experiments reported in these documents showed not only the generation of excess heat, but also the production of helium-4, which provided unambiguous evidence of nuclear reactions occurring. D4 even correlated the excess heat with the helium-4 generation. Furthermore, observation of excess heat in D2 when using deuterium, but not when using hydrogen, showed that the heat must have been caused by nuclear rather than chemical reactions. Together with the results presented in D3 and D5, these documents provided unambiguous proof that

cold fusion did, indeed, work, as there was no other reasonable explanation for the results.

15. As was pointed out, by the appellant, the experiments in D1 to D4 were conducted in ignorance of the alignment of the nuclei with the background magnetic field, such as the Earth's magnetic field. If, therefore, the alignment was accidentally correct, fusion could be observed, and otherwise not. This arbitrary alignment of the spin with the background magnetic field explained the perceived lack of repeatability of these experiments. The invention ensured a correct alignment of the nuclei by applying a magnetic field that was significantly higher than the background.

16. The appellant added that there was no problem in carrying out the invention and that the application provided numerous ways to do so. The invention was based on well-known and well-documented past experiments of cold fusion, such as those disclosed in D1 to D4 and D7. The only additional measure was the controlled application of a magnetic field. The necessary steps of bringing the deuterium atoms to within at most 7 Angstroms from each other (e.g. by infusing them into a metal lattice), of applying a magnetic field, and of ionizing the atoms or modifying their orbits, were all well-known and easy to carry out for the person skilled in the art. Fusion would happen as an inevitable consequence. The stronger the external magnetic field, the more nuclei were properly aligned, and the higher the fusion rate would be.

17. In summary, according to the appellant, the application provided a sound theoretical explanation for cold fusion. Also, the skilled person was aware of

experimental evidence, such as that in D1 to D4, which distinguished the present case from cases T 541/96 and T 1485/17. This notwithstanding, the appellant also pointed out that there was no general requirement to provide experimental data, and referred to several decisions from the Boards of Appeal on that matter.

18. Furthermore, with reference to the decision in case T 1242/04 (OJ EPO 2007, 421) the appellant argued that a search should have been carried out. The exception under Rule 63(2) EPC had to be interpreted narrowly and applied only to those cases where it was not possible to carry out a meaningful search. This, however, was not the case here. In particular, the claimed features could easily have been searched. Possible doubts regarding the technical effect of these features would concern Article 84 or 56 EPC, but had no bearing on the possibility of carrying out a search.

The Board's opinion on the theoretical explanation

19. The appellant's arguments are not persuasive. Contrary to the appellant's assurances, the explanations in the description of how fusion can be achieved at low temperatures in the presence of a magnetic field do not conform to generally recognised theories.

20. Firstly, the disabling of the electromagnetic force by neutrons, and the corresponding insulation of the proton of one deuterium nucleus from the electrostatic repulsion of the proton in a neighbouring deuterium nucleus, defies all recognized theories and experimental results, according to which the repulsion is felt despite the presence of neutrons. In particular, the internal structure of the neutron has

no influence on the electric repulsion. The non-uniform internal charge distribution of the neutron is confined to less than one femtometre and rapidly integrates to zero outside the neutron. The multipole moment of the neutron is extremely small, and any induced dipole moment is far too weak noticeably to reduce the Coulomb barrier. It is true that the strong nuclear force can compensate for the electrostatic repulsion in "nuclear matter" due to the extreme pressures within such exotic matter as is assumed to have existed at the beginning of the universe or within neutron stars. In these extreme cases, it is the pressure that overcomes the Coulomb barrier and that brings the nuclei sufficiently close that the strong force becomes comparable in size to the electrostatic force. These conditions are, however, very different from those under which the invention works. Therefore, the alleged screening effect of neutrons is not credible to the person skilled in the art, who is familiar with the currently established scientific theories.

21. Secondly, regardless of whether there is a screening effect by neutrons or not, it is not apparent how the neutrons and protons within a deuteron can be aligned with each other and with the nucleons of a neighbouring deuteron. The deuteron is predominantly spherically symmetric (S-wave). In order to force a preferred spatial axis on the deuteron, the external interaction energy would need to overcome the energy of the internal nuclear dynamics. However, the strength of the fields and the magnitude of the gradients required for this would be completely unachievable. This is so for electric fields that interact with the deuteron's small electric quadrupole moment, and for magnetic fields that interact with its magnetic dipole moment. Magnetic fields of any realistic strength can only align the

combined spin of the proton and neutron. This has no effect on the internal spatial structure of the deuteron at all. Therefore, even if the electrical insulation effect of the neutron were credible (which it is not), the application would still not disclose how the neutrons and protons can be aligned appropriately.

22. The appellant is right insofar as it was known that aligning the spins ("spin polarization") of deuterium nuclei increases the fusion cross-section, and, consequently, the likelihood of fusion. However, this effect does not increase the cross-section more than by a factor of about 10, which is far below the many orders of magnitude that would be necessary to overcome the Coulomb barrier at the low kinetic energies available in cold fusion.

23. It was also known that influencing the distribution of electrons between the deuterium nuclei - an effect called "screening" - could lower the Coulomb barrier. However, at present, there is no known arrangement that could lower the Coulomb barrier by an amount that would bring cold fusion even remotely within reach of being applicable to energy production. The appellant stated that the invention did not make use of that effect, anyway.

24. As neither the neutron's ability to screen electric fields nor the influence the deuteron's internal spatial composition is credible, it is implausible that the fusion of two deuterons to form helium-4 (plus one photon) should be favoured over the six orders of magnitude more probable fusion channels to form tritium (plus one proton) or helium-3 (plus one neutron).

25. Hence, the application's explanation of why the invention works is not supported by established scientific theories and seems to be based on speculation. This does not necessarily mean that the speculations are wrong. However, it does mean that, in order to be plausible, there should be sufficient experimental evidence, which convincingly demonstrates that the invention does work (see T 1164/11).

The Board's opinion on the experimental evidence

26. The Board is aware of experiments on cold fusion, such as those disclosed in D1 to D4. However, the Board is equally well aware that there are serious problems with the reproducibility of the results. D9 is a recent survey of such problems and summarizes various attempts, by various research groups, to reproduce the past experiments on cold fusion. However, although there is evidence for yet unexplained effects happening in certain crystal structures, none of this is sufficient evidence for cold fusion.

27. The appellant's main explanation for the lack of reproducibility, namely the absence of a properly oriented magnetic field, is not convincing.

28. Firstly, this is because, according to generally accepted theories, the magnetic alignment of the nuclei's magnetic moments (spin polarization) only has a comparatively small effect on the nuclear cross-section, and the probability of fusion. In particular, it has no effect on the spatial configuration of the deuteron and its constituents.

29. Secondly, even if the effect were as suggested by the appellant, magnetic fields only slightly larger than the Earth's magnetic field (which fall within the range used in the invention; see paragraph [0114], point 9; and paragraph [0379] of the published application) would only align a tiny percentage of the deuterium nuclei, because the energies involved (Zeeman energies), are insufficient, by far, to overcome the depolarising effect of thermal energy at room temperature. In fact, the depolarizing effect at room temperature would require an unrealistically strong magnetic field to polarize a significant proportion of the deuterons. Hence, the Board would not expect a noticeable discrepancy between the amount of a purely arbitrary alignment (and corresponding rate of fusion) and the amount of alignment in the presence of an external magnetic field.

30. Thirdly, and still assuming that the suggested effect was present, a palladium crystal structure is such that deuterium nuclei can have neighbouring deuterium nuclei within a distance of 7 Angstroms in almost all spatial directions, and not only along a single axis. Hence, there is a high probability, even for an arbitrary alignment of the crystal with respect to the background magnetic field, that there will be some nuclei within a distance of 7 Angstroms that will be aligned correctly. Considering that, the effects should have been reproducible.

31. According to the appellant, the results presented in D1 to D4 were unambiguous in their empirical evidence of cold fusion. However, the amounts of excess heat are so small that chemical reactions cannot be ruled out. In addition, the amounts of helium-4 measured in D4 are far below the natural concentration if helium in the

atmosphere, which is why contamination can also not be ruled out. In addition, experiments are prone to measurement errors and data analysis errors, particularly so if the signals are not clearly above the background noise. Therefore, in order credibly to demonstrate a new phenomenon, it is indispensable that measurement results be conclusive and confirmed by several independent research groups.

32. Hence, the application not only lacks a persuasive theoretical explanation, but there is also insufficient evidence that the alleged effect of cold fusion actually happened in the experiments disclosed in D1 to D4.

Filing of experimental results

33. The appellant requests the right to bring forward additional experimental results by 30 April 2026.

34. This request is denied because, under Article 12(3) RPBA, the statement of grounds shall contain the party's complete appeal case. There is no right to file later evidence. The issue of insufficient disclosure was already raised by the Search Division and was the sole focus of the examination proceedings. Therefore, any measurement results should have been submitted earlier (Article 12(5) RPBA).

Consequences

35. The problem with the application does not lie in the difficulty of carrying out the claimed method steps of bringing deuterium or tritium atoms closely together,

of applying a magnetic field, and of ionizing the atoms or changing their electron orbits. The appellant is correct in saying that the skilled person would have been able to do those things. Rather, the main problem lies in that it is not credible, in the absence of a persuasive explanation and compelling experimental evidence, that these steps achieve the claimed effect of "converting nuclear energy by fusing deuterium or tritium nuclei", an effect that is the core of the invention.

36. This means that, given the information in the application and the evidence provided by the appellant, the Board is not persuaded that the skilled person, when trying to carry out the method steps of claim 1, would succeed in carrying out the complete method, which includes achieving fusion (on an industrially applicable scale). Therefore, the Board can see no fault can in the Examining Division's finding that the method or system "for converting nuclear energy by fusing deuterium or tritium nuclei" cannot be carried out, contrary to the requirement of Article 83 EPC. In this, the case is similar to the decisions in T 0541/96 and T 1485/17.

37. The lack of a persuasive explanation and of compelling experimental evidence also means that there is no credible disclosure, in the application, of a way of carrying out the invention. Hence, there is also no fault in the Examining Division's finding that the requirement of Rule 42(1)(e) EPC is not met.

38. The ability to carry out the invention is intrinsically linked with industrial applicability. If an invention cannot be carried out, it is also not industrially applicable, and, therefore, not patentable (Articles

52(1) and 57 EPC; see the decisions cited in the Case Law, 11th edition, I.E.2).

39. Given the problems of insufficient disclosure and lack of industrial application, a prior art search would have been meaningless. The purpose of a search is to discover any prior art that is relevant for determining novelty and inventive step (Rule 61(1) EPC). However, carrying out a search for an invention, that is not patentable for reasons that do not involve any comparison with prior art would have served no purpose. In this respect, the present case differs from T 1242/04, which was cited by the appellant. Accordingly, the Board cannot find fault in the decisions of the Search and Examining Divisions, under Rules 63(1) and (2) EPC, not to conduct a search or an additional search.

40. The Board's findings, above, apply to the application as a whole, independent of the particular wording of the claims. Hence, none of the appellant's requests can be allowed.

Order

For these reasons it is decided that:

- The appeal is dismissed.

The Registrar: The Chair:

D. Meyfarth P. Scriven

Decision electronically authenticated