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D E C I S I O N
of 6 May 1998

Case Number: T 0175/96 - 3.2.4

Application Number: 88111985.3

Publication Number: 0301464

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Language of the proceedings: EN

Title of invention:
Breathable fire extinguishing gas mixtures

Patentee:
Air Products and Chemicals, Inc.

Opponent:
Ginge-Kerr Danmark A/S

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
T 0013/84

Catchword:
-

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Case Number: T 0175/96 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 6 May 1998

Appellant: (Proprietor of the patent)
Air Products and Chemicals, Inc.
Route no. 222
Trexlertown
Pennsylvania 18087 (US)

Representative:
Burford, Anthony Frederick
W.H. Beck, Greener & Co.
7 Stone Buildings
Lincoln's Inn
London WC2A 3SZ (GB)

Respondent: (Opponent)
Ginge-Kerr Danmark A/S
111 Stamholmen
2650 Hvidovre (DK)

Representative:
Zeuthen-Aagaard, Henrik
Chas. Hude
33 H.C. Andersens Boulevard
1553 Copenhagen V (DK)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 15 January 1996 revoking European patent No. 0 301 464 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: C. A. J. Andries
Members: R. E. Gryc
J. P. B. Seitz

Summary of Facts and Submissions

I. The appellant (patent proprietor) lodged an appeal, received at the EPO on 15 February 1996, against the opposition division's decision revoking European patent No. 0 301 464 notified by post on 15 January 1996.

The appeal fee was paid simultaneously and the statement of grounds of appeal was filed on 30 April 1996.

II. An opposition was filed requesting revocation of the patent as a whole on the basis of Article 100(a) and 100(b) EPC. The opposition division held that lack of inventive step (Articles 56 EPC) prejudiced the maintenance of the patent having regard to the following documents:

D1: US-A-3 438 445

D29: Naval Submarine Medical Research Laboratory, Memo report 84-5 of D.R. Knight, released: 8 April 1985, first 4 pages and pages 23 to 29 and 50.

The following documents were also cited:

D15: The American Journal of Physiology - volume 146, No. 5 (1 August 1946) - pages 637 to 653 - "A theoretical study of the composition of the alveolar air at altitude" - W.O. Fenn et al.

D16: JFF/Combustion Toxicology, volume 1 (November 1974) - pages 191 to 235 - "Mass life hazard: Experimental study of the life hazard of combustion products in structural fires" - A.J. Pryor et al.

D17: Fundamental and Applied Toxicology 9, pages 236 to 250 (1987). "Effects of exposure to single or multiple combinations of the predominant toxic gases and low oxygen atmospheres produced in fires" - B.C. Levin et al.

D18: Journal of Combustion Toxicology, volume 6 (August 1979) - pages 208 to 211 "Effects of oxygen and carbon dioxide on carbon monoxide toxicity" - F.L. Rodkey et al.

D28: Journal of Aviation Medicine 14 (October 1943) - pages 250 to 261- "The value of carbon dioxide in counteracting the effects of low oxygen" - F.A. Gibbs et al.

III. In the statement of the grounds of appeal, the appellant agreed that the state of the art closest to the invention could be found in document D1. He contended that the present invention relates to the problem of the prolongation of the period for a habitable hypoxic fire extinguishing atmosphere of given oxygen partial pressure (i.e. given concentration at a given ambient pressure) and that there was no prior art proposal to solve this problem.

According to the appellant, D1 is not concerned with the problem of prolonging consciousness and mental acuity in an atmosphere of a given oxygen content and, in the atmosphere created by the method of DI, the carbon dioxide is present as a by-product of combustion and not as a specifically intended component. The appellant remarked that, in D1, there was no teaching that the presence of carbon dioxide is essential or even desirable and that any control should be exercised over the carbon dioxide content.

The appellant also pointed out that most prior art studies relating to carbon dioxide content in hypoxic gas mixtures were concerned with evaluating the toxic effects of carbon dioxide produced as a combustion product (e.g. D16 and D18) or as a respiratory by-product (e.g. D28 and D29).

He contended that there was no consensus as to the effect of carbon dioxide in hypoxic gas mixtures and none of the prior art studies proposed or even indicated, that extraneous carbon dioxide should be added to habitable hypoxic fire extinguishing gases.

The appellant contended also that D29 was not concerned with the problem of extinguishing fires by reducing the oxygen content of the atmosphere to a level which will not support combustion but remains habitable (albeit for a short period of time) and that there was no suggestion therein that any special provision should be made to control carbon dioxide content in the event of a fire or that extraneous carbon dioxide should be added to the atmosphere. According to the appellant, carbon dioxide is present in the atmosphere of a submarine as a respiratory by-product and the art of maintaining a breathable atmosphere is of no relevance to the art of extinguishing fires in a confined but not sealed space as according to the invention.

The respondent (opponent) contradicted the contentions of the appellant and pointed out that D1 teaches how to extinguish a fire by lowering the oxygen content in a confined, but not sealed space (cf D1: column 5, lines 7 to 9) and that the oxygen content is lowered to a level where a human being "can be active and carry out work very effectively for long periods of time".The

respondent was therefore of the opinion that the skilled person could not ignore the problem of maintaining consciousness and mental acuity in case of fire which clearly belongs to his field of competence.

He contended that, after having read D1, it would be obvious to a person skilled in fire extinguishing to investigate the problem of maintaining consciousness and mental acuity in a low oxygen atmosphere in general. Hence, D15, D28 and D29 will all be relevant to the skilled person having already consulted D1.

According to the respondent, the essential idea of the alleged invention, i.e. to add extraneous carbon dioxide with the purpose of permitting maximal utilization of the available oxygen was already disclosed in D28 which describes that the addition of carbon dioxide to low oxygen mixtures permits maximal utilization of the available oxygen.

The respondent also pointed out that both D28 and D29 (using the wording "addition of" and "supplementary" respectively), disclose deliberate addition of extraneous carbon dioxide to hypoxic gases with the very purpose of making them more habitable and that D28 was a scientific and general disclosure which does not refer only to submarines.

The respondent was also of the opinion that, before the priority date, there was no general prejudice against the use of CO2, that the need for an alternative to the CFC-gases as an appropriate means for extinguishing fires had been recognized and that, in 1987, it was obvious to the reader of D1 to continue the study concerning low oxygen atmospheres and the effect thereof on human beings. The teaching of D1, e.g. Figure 4 and the pertaining text, would lead the skilled person in the direction of "high altitude"

problems i.e. towards D15, D28 and D29 and from D1 to the basic idea, i.e. to add carbon dioxide to ensure a sufficiently high, but not excessive carbon dioxide level.

Therefore the respondent considered that, for the skilled person starting from D1 and taking into account the teachings of the above mentioned prior art, it was obvious to arrive at the invention.

IV. Oral proceedings took place on 6 May 1998.

After a general review of the background of the invention, the appellant stated that two categories of prior art documents should be distinguished, i.e. the "fire-fighting prior art" documents and the "low oxygen prior art" documents.

He contended that, in relation with fires, CO2 was generally known as a combustion product and he acknowledged that D1 taught before the priority date the use of CO2 in an extinguishing gas but only in a small amount.

As far as the low oxygen problem is concerned, the appellant drew attention to the fact that, in the prior art documents cited in the procedure, this problem was considered only in relation with altitude (aircrafts) or aboard submarines in order to reduce the risks of fires (fire safety) but never for extinguishing existing fires.

He pointed out that D28 was an academic report suggesting no practical application and that D29 was simply a review paper referring back to an old period and old documents. He was of the opinion that D1 disclosed the closest prior art and that D17 was more relevant as all the other cited documents since it

reflects, at approximately the filing date of the patent, the knowledge of the skilled person about gases and low oxygen atmospheres produced in fires.

The appellant argued also that D1 was concerned with the problem of providing a comfortable atmosphere without steam and not with the problem of sustaining (prolonging) consciousness as according to the invention and that the solution proposed in D1 was only to provide more air and not CO2.

He concluded that, at the priority date, there was no bridge between D1 and the other documents and a prejudice existed against the introduction of CO2 in fire atmospheres.

The respondent (opponent) contradicted the contentions of the appellant and referred to Figure 4 and to column 5, lines 43 to 67 of D1 to demonstrate that when consulting D1, it would be relevant to the skilled person to refer to a literature concerning low oxygen content atmospheres such as D15, D28 or D29.

According to the respondent, the skilled person would get from D15 the general idea of adding CO2 in a low oxygen content atmosphere and he would find in D28 tests demonstrating that the cortical activity is related to the CO2 tension rather than to the oxygen tension and that normal brain function can be maintained in spite of low content of O2 in the inspired air provided that the carbon dioxide tension is maintained.

The respondent also pointed out that D29 refers to D28 and concerns fire safety. He referred to some passages of D29 describing that carbon dioxide may protect performance by supporting oxygen transport to the brain and enhances the hypoxic stimulation of ventilation,

the venous return to the heart and cerebral blood flow. The respondent did not agree that, at the priority date, there could be a prejudice against the introduction of CO2 in fire atmospheres and conclude that, starting from D1, it was obvious to the skilled person to arrive at the invention when consulting one of the documents concerning low O2 content atmospheres like D15, D28 or D29.

At the end of the oral proceedings, the appellant requested that the decision under appeal be set aside and that the patent be maintained as granted

The respondent requested that the appeal be dismissed.

V. The wording of Claim 1 as granted reads as follows:

"A method for controlling and extinguishing fires in a confined aircontaining space while maintaining the confined space habitable for mammalian life, in particular human life, by introducing into the confined space an effective amount of an extinguishing gas comprising carbon dioxide and an inert gas to lower the oxygen content of the atmosphere of the confined space to a concentration in the range of 8 to 15 percent by volume oxygen such that the atmosphere in the confined space will not support combustion but will support mammalian life, characterized by utilizing an extinguishing gas having a sufficient carbon dioxide concentration so that upon introduction of the extinguishing gas into the confined space the carbon dioxide content of the confined space is increased to a concentration in the range of 2 to 5 percent by volume carbon dioxide which will increase brain blood flow and brain oxygenation in mammals, whereby consciousness for the mammalian life present in the confined space is sustained without producing incapacitating dyspnea."

Reasons for the Decision

1. Admissibility of the appeal.

After examination the appeal has been found to be admissible.

2. *Interpretation of Claim 1*

The expression "confined space" used several times in Claim 1, respectively in lines 12, 13, 14, 15, 16, 18, 19 and 21 of page 14 of the patent specification, has to be interpreted as meaning: "confined but not sealed space" since, according to Claim 1 itself, the oxygen content of the atmosphere in the confined space is lowered by the introduction of the extinguishing gas i.e. it means that the air present in the enclosed area can escape when displaced by the incoming gas.

This interpretation not only is supported in particular by the following passages of the description as filed: page 5, lines 8 to 11 and 27 to 30 and page 26, lines 5 to 9, but has also been put forward by the appellant.

3. *Novelty (Article 54 EPC)*

The Board is satisfied that none of the cited documents discloses a method for controlling and extinguishing fires comprising in combination all the features described in Claim 1.

Since novelty was not disputed by the respondent, the Board considers that there is no need for further detailed substantiation and that the subject-matter as set forth in Claim 1 is new within the meaning of Article 54 EPC.

4. *Closest state of the art*

In agreement with both parties, the Board has considered that the state of the art closest to the invention was disclosed in D1 since this document describes a method for controlling and extinguishing fire in a confined space while maintaining it habitable for mammalian life, said method comprising all the features cited in the precharacterising portion of Claim 1.

Moreover, the Board considers that D1 is also concerned with the problem of creating a comfortable atmosphere in which any trapped occupants can remain active (see D1, column 1, lines 12 to 15 and 27 to 33).

The subject-matter of Claim 1 differs from said closest state of the art in that the claimed gas mixture to be introduced in the confined but not sealed space contains sufficient carbon dioxide to increase the carbon dioxide content of said space to a concentration in the range of 2 to 5% by volume for sustaining consciousness of the occupants.

5. *Problem and solution*

When starting from the method of D1 and considering the differences between the subject-matter of Claim 1 and said known method, the related problem as objectively determined (see in particular decision T 13/84, OJ EPO 1986, 253) appears to be to improve the fire extinguishing gas mixture known from D1 so that it would extend the period of time during which the occupants of the confined space remain conscious and active.

The Board is satisfied that the solution claimed in Claim 1 would improve the method of D1 accordingly.

6. *Inventive step (Article 56 EPC)*

6.1 D1 relates to creating an atmosphere, which is non toxic to human life (see column 2, lines 10 to 12), in a burning confined but not sealed structure. From D1, the skilled person would learn that the gaseous mixture blown into the inside of a burning structure would create a positive pressure therein causing an outflow of the gaseous mixture thus clearing the smoke (see for example column 4, lines 58 to 61; column 5, lines 7 to 9 and column 6, lines 40 to 43), the used gaseous mixture comprising an oxygen and carbon dioxide content of 2 to 5% of the total by volume, the rest being nitrogen (see D1: column 4, lines 41 to 43).

Although D1 hints that, within the atmosphere created according to the described method, the occupants can "even carry out work" (see D1: column 1, lines 31 to 33), it appears from the global teaching of D1 that the main concern of this document is to reveal a method for either creating an atmosphere just capable of supporting human life (see for example D1: column 2, lines 23 and 36, 37; column 6, line 67; column 7, lines 6 and 71, 72 and column 8, lines 16, 23 and 61) while suppressing the fire or, as an alternative, delivering an inert gas for a quicker smothering of all combustion without sustaining life (see D1: column 2, lines 37 to 40).

The global teaching of D1 neither prompts the skilled person to improve the method in order to lengthen consciousness and mental acuity of the occupants of the confined space nor suggests to increase the concentration of carbon dioxide in the confined space for any other purpose.

6.2 The fire extinguishing gaseous mixture, created by the method according to D1 being produced by a burner upon request when needed, is not immediately available after the fire has been discovered and, until the mixture be introduced into the confined space, a non negligible amount of smoke fumes and toxic gases such as carbon monoxide (CO) and hydrogen cyanide (HCN) can be produced by the fire. Consequently, even if the flames are snuffed out "quickly" and the distribution of the extinguishing gases throughout the burning structure is "relatively quick" after introduction of the mixture (see D1: respectively column 4, lines 56 to 58 and column 5, lines 9 to 12), it may nevertheless last a certain time until the smoke and toxic gases accumulated in the confined space be cleared out and a non toxic and comfortable atmosphere be re-established.

Consequently, during a period of time from just before the introduction of the extinguishing gas mixture until the fire is completely out and the confined space cleared out, the duration of said period depending on the burning material, of the importance of the fire and of the volume of the confined space, the skilled person could not expect to find in it a non-toxic atmosphere comparable with the open air atmosphere found at high altitude or with the normal atmosphere aboard a submarine or in a diving-bell.

6.3 In this context, the skilled person would not have any reason to consult general theoretical or experimental studies (such as D15, D28 and D29) about the physiological consequences of the inspiration of air without toxic gases containing CO2 either at high altitude or in aerohypoxic confined spaces free of toxic gases (submarines).

The Board considers that, at the priority date, the skilled person wishing to improve the method known from D1, would preferably search for recent prior art documents such as D16, D17 and D18 treating of critical situations of mammalians trapped in a burning confined space comparable with the situation of the trapped occupants according to D1.

6.4 Now, from D16, which has published in 1974, the results of a study conducted to determine the significance of human exposure to combinations of four variables (temperature, O2, CO and CO2) found within a mass fire environment, the skilled person would learn that:

- "levels of variables that were not lethal by themselves or in combinations of two variables, proved to be lethal when three were combined" (see D16: page 231, end of the first paragraph).

From D17, which reports information divulged in meetings held in 1985 and 1986 (i.e. approximately at the same period as the filing of the opposed European patent) and which concerns the effects of exposure to combinations of toxic gases and low oxygen atmospheres produced in fires, the skilled person would also learn in particular that:

- "synergistic effects have been found when the animals are exposed to certain combinations of CO and CO2" and "decreasing the O2 concentration in the presence of various mixtures of the other major fire gases increased the toxicity even further" (see D17: Abstract, page 236),

and that:

- "There is a range of CO concentrations (2500 to 4100 ppm) which when presented alone to the animals has a very low probability of causing death, but in the presence of CO2 (>1,5%) will act with a much higher probability to cause the death of the animals" (see D17: from page 246, last paragraph to page 247 line 2).

Additionally, D18 published in 1979, would teach the skilled person in particular that:

- "Carbon monoxide is the major toxic gas produced by most fires. In confined spaces the decrease in O2 content and increase in CO2 associated with combustion contribute in a major way to the physiological response to the fire atmospheres" (see D18: page 208, lines 8 to 10 of the introduction),

and that:

- "Fire gas atmospheres, especially in closed spaces, contain lower oxygen with higher carbon dioxide and carbon monoxide than normal air. Data on MST (mean survival time) in rats cannot be directly transposed to human reactions. It is clear, however, that hypoxia alone as well as elevated CO2 cause a decrease in MST" and "one can expect that the time during which an human could

respond to or escape from a fire will be lowered in a similar manner even when fatal levels of COHb (carboxyhemoglobin) are not reached" (see D18: page 211, 3rd paragraph).

6.5 In most outbreaks of fires, the probability being very high that the burning confined space be at least partially filled by toxic gases before the introduction of the extinguishing gas, the skilled person taking into account the above-mentioned clear warnings of D16, D17 and D18 would be reluctant to introduce into said confined space more carbon dioxide in addition to the carbon dioxide resulting from the combustion for fear that an increased concentration of CO2 increases further the toxicity of the other toxic gases (in particular CO and HCN).

Moreover, D15, D28 and D29 which teach respectively that CO2 added to the inspired air permits a high ventilation rate (see D15: end of page 650), increases pulmonary ventilation (see D28: page 260, right column, last paragraph) and enhances the hypoxic stimulation of ventilation, venous return to the heart and cerebral blood flow (see D29: page 27, last six lines and page 26, line 1) would also not incite the skilled person to introduce an additional amount of CO2 in the confined space for fear that it would accelerate the inspiration of the toxic gases by the occupants and thus the lethality of the products of combustion and would have a detrimental effect to the human life contrary to what was expected from said introduction.

6.6 For the foregoing reasons, the Board considers that the use of an extinguishing mixture comprising sufficient carbon dioxide concentration in order to increase the CO2 content of a confined burning space goes in the

opposite way to the normal thinking of the skilled person taking into consideration the teachings of the relevant prior art documents and, thus, does not follow plainly and logically from said prior art.

6.7 Therefore, the subject-matter of Claim 1 as granted of the opposed European patent implies an inventive step within the meaning of Article 56 EPC.

7. The subject-matter of that Claim 1 therefore is patentable according to Article 52 EPC so that the opposed patent can be maintained unamended.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained unamended.

The Registrar: The Chairman:

N. Maslin C. Andries

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