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**Datasheet for the decision  
of 27 October 2023**

**Case Number:** T 1407/20 - 3.2.03

**Application Number:** 15894513.9

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**IPC:** F25B15/00, F25B15/04, F25B15/06

**Language of the proceedings:** EN

**Title of invention:**  
LOW-POWER ABSORPTION REFRIGERATOR MACHINE

**Applicant:**  
Consejo Superior de Investigaciones Científicas  
(CSIC)

**Headword:**

**Relevant legal provisions:**  
EPC Art. 56  
RPBA 2020 Art. 13(2)

**Keyword:**  
Inventive step - (no) - technical prejudice in the art (no)  
Amendment after summons - exceptional circumstances (no)

**Decisions cited:**

**Catchword:**



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Case Number: T 1407/20 - 3.2.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.03**  
**of 27 October 2023**

**Appellant:** Consejo Superior de Investigaciones Científicas  
(Applicant) (CSIC)  
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**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted on 16 January 2020  
refusing European patent application No.  
15894513.9 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** C. Herberhold  
**Members:** B. Goers  
D. Prietzel-Funk

## **Summary of Facts and Submissions**

- I. European patent application No. 15 89 45 13 relates to a low-power absorption refrigeration machine with an exterior and an interior unit, wherein the interior unit comprises a direct expansion evaporator.
- II. By way of the impugned decision, the examining division refused the application.

In its decision the examining division concluded that the subject-matter of claim 1 of the sole request ("main request") did not involve an inventive step.

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

- III. At the oral proceedings the appellant's final requests were as follows.

The appellant requested that the decision be set aside and that a patent be granted based on the main request (the request on which the appealed decision was based and filed by letter dated 25 October 2019), or, subsidiary, on any of auxiliary requests 1 or 3.

Auxiliary request 1 was filed with the statement setting out the grounds of appeal, and auxiliary request 3 was filed during oral proceedings before the Board. Auxiliary request 2 was withdrawn during the oral proceedings.

- IV. Evidence relevant to this decision

D1: EP 2 133 636 A1

D5: US 5 216 891 A

D8: R Zogg, M Feng, D Westphalen: "Guide to Developing Air-Cooled LiBr Absorption for Light Commercial Combined Heat and Power Applications", Distributed Energy Program Report, US Department of Energy, April 2005

V. Claims relevant for this decision

(a) Claim 1 of the main request reads as follows (feature numbering added in "[ ]"):

"[1] A low-power absorption refrigeration machine for use in climate control or air conditioning installations that comprises a working solution characterised in that it comprises an exterior unit (200) and an interior unit (100), wherein the exterior unit (200) comprises:

- [2] an absorber (3) configured to maintain a low pressure and low evaporation temperature when the outside temperature is high, being directly cooled by outside air or by water, and configured to carry out separated heat and mass transfer processes,
- [3] a condenser (11) directly cooled by outside air,
- [4] at least one refrigerant generator (1), and a heat recuperator (9),  
[5] and wherein the interior unit comprises:
- [6] at least one expansion valve (13, 23, 24, 33, 34, 35, 43, 44, 45, 53, 54, 55, 56),
- [7] an expansion evaporator (12),  
[8] wherein the at least one expansion valve (13, 23, 24, 33, 34, 35, 43, 44, 45, 53, 54, 55, 56) connects the condenser (11) to the expansion evaporator (12) through a duct wherethrough a liquid refrigerant flows at high pressure by means

*of a refrigerant in liquid state and in vapour state, wherein the at least one expansion valve (13, 23, 24, 33, 34, 35, 43, 44, 45, 53, 54, 55, 56) reduces the pressure and temperature to the operating values of the evaporator (12), which in turn comprises:*

- *[9] a liquid refrigerant distributor (103),*
  - *[10] a water/air heat exchanger (104),*
  - *[11] a water or ammonia vapour collector (105) integrated in the evaporator (12), and*
  - *[12] a fan (107)*
- [13] wherein the evaporator (12) is a direct expansion evaporator (12) intended to be disposed in an enclosure (18) to be air conditioned, the exterior unit (200) is separated from the interior unit (100) thus configuring a split type machine and both units (200, 100) being connected by two ducts: a duct (110) wherethrough the liquid refrigerant flows from the condenser (11) to the evaporator (12) at high pressure and a duct (106) that transports the vaporised refrigerant from the evaporator of the interior unit (100) to the exterior unit (200), once said refrigerant has flowed through the evaporator (12) and wherein the fan (107) is configured to suction the air of the enclosure (18) to be air conditioned and configured to impel it cooled and mix it with hot air of the enclosure."*

- (b) Claim 1 of auxiliary request 1 has the following amendments to feature groups [1], [10] and [11] compared with the main request (marked in bold and strike-through):

"[1'] A low-power absorption refrigeration machine for use in climate control or air conditioning

installations that comprises a working solution **being LiBr/H<sub>2</sub>O** characterised in that it comprises an exterior unit (200) and an interior unit (100), wherein the exterior unit (200) comprises:

...

- [10'] a ~~water~~ **refrigerant**/ air heat exchanger (104),
- [11'] a water ~~or ammonia~~ vapour collector (105) integrated in the evaporator (12), and..."

(c) Claim 1 of auxiliary request 3 has the following amendments to feature groups [9], [10'] and [13] compared with auxiliary request 1 (highlighted in bold):

"...

- [9'''] a liquid refrigerant distributor (103), **wherein the refrigerant is water;**
  - [10'''] a refrigerant/air heat exchanger (104), the refrigerant being the water, **wherein the refrigerant/air heat exchanger (104) comprises a set of finned tubes;**
  - [11'] a water vapour collector (105) integrated in the evaporator (12), and
  - [12] a fan (107)
- [13'''] wherein the evaporator (12) is a direct expansion evaporator (12) intended to be disposed in an enclosure (18) to be air conditioned, **wherein in the evaporator (12), the water acting as the refrigerant which is fed by the liquid refrigerant distributor (103), circulates through the interior of the tubes of the refrigerant/air heat exchanger (104), wherein the external fluid is the air of the room or enclosure to be cooled (18), which circulates through the exterior of the tubes and is cooled as a consequence of the low temperature produced by the evaporation of the**

**refrigerant at low pressure in the interior of the tubes, wherein** the exterior unit (200) is separated from the interior unit (100) thus configuring an **air-air** split type machine and both units (200, 100) being connected by two ducts:

a duct (110) wherethrough the liquid refrigerant flows from the condenser (11) to the evaporator (12) at high pressure and a duct (106) that transports the vaporised refrigerant from the evaporator of the interior unit (100) to the exterior unit (200), once said refrigerant has flowed through the evaporator (12) and wherein the fan (107) is configured to suction the air of the enclosure (18) to be air conditioned and configured to impel it cooled and mix it with hot air of the enclosure."

VI. The appellant's arguments, where relevant to the present decision, can be summarised as follows.

(a) Main request and auxiliary request 1 - inventive step

The subject-matter involved an inventive step. Starting from D1 as the closest prior art, the distinguishing features were not made obvious by D8 or D5. D8 demonstrated that there was a technical barrier to applying a direct expansion heat exchanger in an absorption refrigeration machine which had lithium bromide/water as the working fluid and was operated at low pressures. D8 instead pointed to other solutions, such as a secondary cooling loop ("re-cooling") system or a vertical falling-film absorber. In addition, neither D8 nor D5 disclosed a direct expansion heat exchanger with a liquid distributor and a vapour collector.

(b) Admittance of auxiliary request 3

Auxiliary request 3 was to be admitted into the proceedings. There were special circumstances since the amendment was a direct response to arguments raised for the first time in the Article 15(1) RPBA 2020 communication, which further included an invitation to submit such an amendment. Moreover, the amendments were suitable for establishing an inventive step.

## Reasons for the Decision

### 1. Main request - inventive step

The subject-matter of claim 1 does not involve an inventive step, as also concluded in the appealed decision.

#### 1.1 D1 represents the closest prior art and discloses an absorption refrigeration machine for air conditioning of an enclosure. As is also the case in the application, in the main embodiment the machine in D1 applies a lithium bromide (LiBr)/water working solution (see e.g. paragraph [0001]).

D1 discloses, *inter alia*, two distinct designs of the evaporator and absorber part of the machine. In a first embodiment, the evaporator and the absorber are configured as separate units (see Figures 1, 7 and 8).

In a second embodiment, an integrated evaporator-absorber as shown in more detail in Figures 9 to 14 is suggested (see paragraph [0056]).

The starting point of the inventive-step discussion is the first embodiment.

#### 1.2 Distinguishing features from D1

##### 1.2.1 Undisputedly, D1 does not disclose a direct expansion evaporator with the refrigerant being in direct heat exchange with the air of an enclosure. Instead D1 includes an evaporator (12) in combination with a secondary heat transfer loop (19, 20, 21) extracting

heat from the enclosure to be air-conditioned by an additional heat exchanger (21).

1.2.2 In addition, the appellant considered the following features of claim 1 to be distinguishing features:

- in D1, no distinction was made between an exterior and an interior unit (features [1] and [5]),
- the evaporator in D1 did not include a liquid distributor and a vapour collector in the sense of claim 1 (features [9] and [11] in combination with feature [13]) and
- the fan in D1 (see Figure 1, reference sign 22) was not configured to suction the air of the enclosure to be air-conditioned and configured to impel it cooled and mix it with hot air of the enclosure (feature [12] in combination with feature [13]).

However, the Board agrees with the appealed decision in that providing a direct expansion heat exchanger is the sole difference from D1. The reasons are as follows.

(a) Exterior and interior unit

The distinction between an exterior and an interior unit in claim 1 cannot establish a difference from D1.

The claim groups the elements of the absorption refrigeration machine into two sub-units, which are an "exterior" and an "interior" unit; however, the exact location of the exterior or interior unit with respect to an installation environment of the absorption refrigeration machine (which is undefined in claim 1) is not derivable from claim 1. Further restrictions, such as providing separate housings of the units or a

specific distance between the units, is also not implicit in these terms.

The description of the application does not provide a better understanding either. By contrast, in Figure 1 the expansion valve (13) is not part of the interior unit (100), contrary to the definition in claim 1.

Compared with D1, there may be clear-cut cases not falling under the definition of features [1] and [5], e.g the second embodiment (Figures 9 to 14 of D1) with the integral absorber-evaporator; however, in view of the first embodiment of D1 (see Figures 1, 7, 8), this grouping into units cannot establish a difference. The mere fact that both sub-units are connected by two ducts is an inherent necessity; these ducts are the inlet and outlet of the evaporator.

(b) Liquid distributor and vapour collector

While in the appealed decision reference was only made to the second embodiment (Figure 12) of D1 to establish that features [9] to [11] are disclosed in D1 (the second embodiment not considered here), the Board notes that any evaporator including that disclosed in the first embodiment of D1 includes a liquid refrigerant distributor (the liquid inlet to the heat exchanger) and a vapour collector (the vapour outlet of the heat exchanger).

Contrary to the appellant's view, the term "distributor" in feature [9] is not limited to embodiments in which the incoming liquid is sub-divided into several parallel flow paths. Any evaporator requires the incoming liquid to be distributed over the heat transfer surface at the inlet. Even in a straight-

tube heat exchanger the liquid is "distributed" over the heat transfer area, which is the inner tube surface. This understanding applies, *mutatis mutandis*, to the "vapour collector" in feature [11]. The skilled person has no reason to interpret the claim wording in a more restrictive manner as such.

Even if the skilled person considered the description for the interpretation of the terms "distributor" and "collector" in claim 1, they would not come to a more limiting interpretation.

The only detailed description of an embodiment of the direct expansion heat exchanger in the application relates to the embodiment which is schematically shown in Figures 1 to 5 (see page 9, line 31 to page 10, line 22); however, this disclosure does not show the details of the direct expansion heat exchanger in a clear and unambiguous manner. In the figures the elements "distributor 103", "evaporator 12" and "vapour collector 105" are indicated by blocks and lines without connections or without being in any technically meaningful arrangement. Therefore, the figures do not make it possible to draw any conclusion on a particular design of the heat exchanger. In the description of the application reference is made to a "set of finned tubes" (page 10, lines 10, 20 and 21) and that the liquid "circulate through the interior of the tubes" (page 10, lines 16 and 17); however, claim 1 does not mention anything regarding the use of any tubes. In addition, the cited passage does not specify whether these tubes are connected in parallel or in series. As already discussed, this is not apparent from the figures either.

The appellant also argued that a specific design of the direct expansion heat exchanger was implied in order to enable operation of the direct heat exchanger at the low operating pressure (see page 9, on which a range of 10 to 15 mbar is mentioned), but this is not convincing since the pressure range is not defined in claim 1 as a functional restriction. Only the operating pressure of the absorber is specified in claim 1 by a relative definition ("low pressure"), the same wording being used in D1 to describe the operating pressure of the absorber in the first embodiment. The application does not describe which design constraint on the heat exchanger such a functional requirement would imply, either.

Therefore, the evaporator 12 in Figure 1 discloses features [9] to [11] of claim 1 at least implicitly.

(c) Fan

The fan (22) in Figure 1 of D1 is in contact with the heat exchanger (21) of the indirect heat exchange cycle in the enclosure to be air-conditioned. Although not interacting with an expansion heat exchanger that is not present, this fan 22 anticipates the fan according to feature [12] as it also fulfils the function defined in feature [13] of "suction the air of the enclosure" and "impel it cooled and mix it with hot air of the enclosure".

1.3 Objective technical problem

The examining division considered the objective technical problem to be that of "how to modify the refrigeration system such that the water cycle is not

necessary in order to reduce the complexity of the system when cooling is required on site".

The Board agrees with the appellant's view that this problem contains parts of the solution ("how to modify the refrigeration system such that the water cycle is not necessary"), thereby relying on an *ex post facto* view.

In the application as filed, the motivation for using a direct expansion evaporator is disclosed in paragraphs [0009] and [0022]. Here, reference is made to reduced costs (both operational and investment costs) and reduced complexity of the system.

Hence, the objective technical problem is to reduce costs and the complexity of the absorption refrigeration system.

- 1.4 Starting from prior-art document D1, the solution is obvious in view of the disclosure of document D8.
- 1.4.1 D8 provides an overview of the absorption refrigeration machine technologies using lithium bromide as the working solution (see D8, page 1, "background"). D8 is thus considered to represent the common general knowledge for this technology at its time of publication available to the skilled person when seeking to solve the objective technical problem.
- 1.4.2 According to D8 both indirect and direct expansion evaporation systems were known technologies in the heating, ventilation and air conditioning (HVAC) field used as standard in vapour-compression refrigeration systems (see D8, chapter 6.1.5., page 21). The main advantage of using a direct expansion evaporation

system in absorption refrigeration machines is according to D8:

- that the overall temperature lift can be reduced.

This is due to the omission of the indirect heat exchange cycle requiring an additional heat difference. D8 also mentions further disadvantages of the secondary cooling loop (see D8, chapter 6.1.4, page 20):

- additional parasitic losses (both pump and fan required) and
- requirement for freeze protection of the secondary fluid.

The Board agrees with the examining division's conclusion that, in view of this teaching, the skilled person would at least consider exchanging the indirect expansion evaporator system for a direct one in order to provide a solution to the objective technical problem.

- 1.4.3 As far as it is also stated in D8 that direct expansion evaporators used in vapour-compression equipment are "unlikely to work satisfactorily in LiBr absorption systems" and that this "require developing a new evaporator design" (D8, page 21, point 6.5.1), this is not considered to be leading away from the claimed solution as argued by the appellant. This was also concluded in the appealed decision: "Although a new constructional design of the evaporator might be necessary, this would not demotivate the skilled person from using a DX [direct expansion] evaporator."

The appellant argued that this statement was an invitation to perform a research program rather than

direct and unambiguous teaching of how to put such a direct expansion evaporator into practice; however, as explained above (see point 1.2.2 and in particular point (b) here), the application does not disclose any details of the design of the direct expansion evaporator either. The application thus does not make any contribution over the teaching of D8, either in the claims or anywhere in the specification.

Assuming in the appellant's favour that the requirements of Article 83 EPC with respect to the design of a direct expansion heat exchanger for application in the claimed low-power absorption refrigeration machine are met, the subject-matter of claim 1 does not involve an inventive step because then the design of the direct expansion evaporator for use in systems with a lithium bromide/water working solution according to claim 1 is not critical and is within the skilled person's capabilities after considering the teaching of D8.

- 1.4.4 As far as the appellant points to alternative solutions in D8, both the falling-film absorber (figure 7, page 18) and the system with a secondary cooling loop (referred to as the "re-cooling system" by the appellant; see figure 11, page 21) are specific absorber design solutions and as such do not provide teaching leading away from considering a direct expansion evaporator. It is further noted that all arguments with respect to a particular low operating pressure, such as crystallisation problems, are not relevant, since claim 1 does not include a functional restriction for a specific range of low evaporator operating pressures.

1.5 Starting from prior-art document D1, the solution is also obvious in view of the disclosure of document D5.

1.5.1 D5 also discloses an absorption refrigeration machine with lithium bromide/water as the main embodiment of the working solution (see column 4, line 19 to 25). In the evaporation systems disclosed in Figures 1 and 2 of D5, a direct expansion evaporator (13, 57) is placed directly in the enclosure to be air-conditioned ("indoors"). While no design details are disclosed in D5, it is at least disclosed that the direct expansion evaporator has a plurality of heat exchange channels ("evaporator coils 14/58") to which the liquid inlet is distributed and from which the vapour is collected when operated in the cooling mode (see column 4, lines 59 to 67). The "indoors" air is subjected to the effects of the evaporator and cooled ("spatial air to be cooled is blown through [the] evaporator").

The skilled person thus learns from D5 that a secondary heat exchange loop for the evaporator is not necessary and a direct expansion evaporator can simplify the machine structure.

As previously discussed in the context of D8, there is no principle technical prejudice in the common general knowledge against doing so, which is likewise confirmed by the use of such a direct expansion evaporator in D5.

1.5.2 The appellant argued with respect to D5 that "the technology of the absorber [used in D5 at that time] did not allow it to aspirate the water vapour produced in the evaporator [at low pressure levels]"; however, this problem is already solved in the document taken as a starting point, D1, which discloses an absorber

suitable for low pressure applications (see D1, e.g. paragraph [0012]).

2. Auxiliary request 1 - inventive step

Also the subject-matter of claim 1 of auxiliary request 1 does not involve an inventive step.

The only further restriction introduced in claim 1 of auxiliary request 1 compared with the main request is that the working fluid is now specified as being LiBr/H<sub>2</sub>O, i.e. a mixture of lithium bromide as the absorbent and water as the refrigerant.

As already discussed above, D1 is directed to absorption refrigerator systems comprising LiBr/H<sub>2</sub>O as the working fluid. Compared with claim 1 of the main request, claim 1 of auxiliary request 1 thus does not add any further distinguishing features over D1.

Therefore, the conclusions with respect to inventive step for the main request also apply, *mutatis mutandis*, to auxiliary request 1.

3. Auxiliary request 3 - admittance

Auxiliary request 3 is not admitted into the appeal proceedings for the following reasons.

3.1 Auxiliary request 3 was filed for the first time during oral proceedings before the Board and is thus an amendment to the appellant's appeal case according to Article 13(2) RPBA 2020. Such amendments will, in principle, not be taken into account unless there are

exceptional circumstances, which have been justified with cogent reasons by the party concerned.

- 3.2 The appellant invoked exceptional circumstances by arguing that it was made aware for the first time that the detailed design of the evaporator was decisive for the question of inventive step only in the Board's communication under Article 15(1) RPBA 2020.

This is not persuasive.

- 3.2.1 Not only were features [9] to [11] (describing a liquid refrigerant distributor and a water vapour collector of the direct heat exchanger) of the main request already part of the discussion of the distinguishing features over D1 in the appealed decision, but the relevance of the design of a direct expansion evaporator used in LiBr systems was also already a central part of the discussion of the common general knowledge disclosed in D8 (see D8, chapter 6.1.5, page 21), which was discussed in the examining proceedings and in particular also in the appealed decision; see e.g. point II.13.7.2, last sentence. Therefore, respective amendments could and should have been submitted during the examination proceedings, or at the latest with the statement setting out the grounds of appeal.

- 3.2.2 The fact that in the Article 15(1) RPBA 2020 communication the Board noted that claim 1 did not encompass any features further characterising the evaporator does not constitute exceptional circumstances either, as this passage merely addresses the points already discussed in the examining proceedings.

3.2.3 Furthermore, even when additionally considering the criteria applied for the admittance under Article 13(1) RPBA 2020, the amendments made to auxiliary request 3 do not *prima facie* overcome the issues raised against auxiliary request 1 under Article 56 EPC (see point 2. above).

Compared with what was concluded above with respect to the combination of D1 and D5, the only further restriction not encompassed by this combination is that the tubes of the direct expansion evaporator are finned; however, providing fins in order to improve the heat transfer is common general knowledge in the field of heat exchangers, which was not contested by the appellant.

4. Since the appellant's main request and auxiliary request 1 are not allowable and auxiliary request 3 is not admitted into the proceedings, the appeal is not allowable.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:



C. Spira

C. Herberhold

Decision electronically authenticated