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**D E C I S I O N**  
**of 29 September 1999**

**Case Number:** T 0009/97 - 3.2.3

**Application Number:** 90310852.0

**Publication Number:** 0423976

**IPC:** F25B 31/00, F25B 41/04,  
F04B 39/06, F04B 49/10

**Language of the proceedings:** EN

**Title of invention:**  
Compressor refrigeration system with demand cooling

**Patentee:**  
Copeland Corporation

**Opponent:**  
Bitzer Kühlmaschinenbau GmbH & Co. KG

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56, 114(2)

**Keyword:**  
"Inventive step (yes)"

**Decisions cited:**  
-

**Catchword:**  
-



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Boards of Appeal

Chambres de recours

Case Number: T 0009/97 - 3.2.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.3**  
**of 29 September 1999**

**Appellant I:** Bitzer Kühlmaschinenbau GmbH & Co. KG  
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71065 Sindelfingen (DE)

**Representative:** Beck, Jürgen, Dr. Dipl.-Phys.  
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**Appellant:** Copeland Corporation  
(Proprietor of the patent) 1675 W. Campbell Road  
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Ohio 45365-0689 (US)

**Representative:** Senior, Alan Murray  
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**Decision under appeal:** Interlocutory decision of the Opposition Division  
of the European Patent Office posted 5 November  
1996 concerning maintenance of European patent  
No. 0 423 976 in amended form.

**Composition of the Board:**

**Chairman:** C. T. Wilson  
**Members:** J. B. F. Kollar  
J. P. B. Seitz

## Summary of Facts and Submissions

I. The mention of the grant of the patent No. 0 423 976 in respect of European patent application No. 90 310 852.0 filed on 4 October 1990 and claiming the priority of 17 October 1989 from an earlier US-application, was published on 9 March 1994 on the basis of 12 claims, of which claim 1 in the form of a feature analysis reads as follows:

"1.1 A refrigeration system including a compressor (10) having a suction manifold (52) and a discharge chamber (58),

1.2 a condenser (16),

1.3 an evaporator (18)

1.4 connected to said compressor (10) in a serial closed loop system, and

1.5 means (30) for preventing overheating of said compressor (10) comprising

1.6 a sensor (32) for sensing the temperature of compressed gas,

1.7 a fluid line (36, 42) connected between the outlet (20) of said condenser (16) and said compressor (10) and

1.8 control means (34, 38) operative selectively to control fluid flow from said condenser outlet (20) to said compressor (10) in response to the

sensed temperature of said compressed gas,  
characterised in that

1.9 the sensor (32) is within the discharge chamber  
(58) of said compressor (10) and in the direct  
flowpath of said compressed gas,

1.10 the control means comprises

1.11 a positively acting control valve (38)

1.12 capable of shutting off the flow of fluid  
through said fluid line (36, 42) and in that

1.13 an orifice (40) is provided between the valve  
(38) and the compressor (10)

1.14 sized to provide a pressure drop thereacross  
when the valve (38) is open to limit fluid flow  
through the fluid line thereby to inhibit  
flooding of the compressor (10)."

II. On 8 December 1994 the opponent filed a notice of  
opposition against the grant of the patent and  
requested revocation thereof in entirety for lack of  
inventive step under Article 100(a) EPC.

The following prior art was considered in the  
proceedings:

D1: US-A-3 913 346

D2: US-A-4 258 553

- D3: US-A-4 049 410
- D4: Danfoss Instructions TEAT, Kl.14.B1.52, 1977,  
pages 62, 63
- D5: Evidence concerning the public availability of a  
piping diagram TCMO 28 R22 and the delivery of a  
compressor configured according to this diagram to  
Greece in December 1988, comprising:
- D5a: Sabroe Refrigeration A/S, Piping diagram TCMO 28  
R22, drawing number 4849-067;
- D5b: letter of Mr.Braendgaard of 9 October 1996
- D5c: Invoice of Sabroe Refrigeration A/S dated  
12 January 1989 concerning order No. 381.2090
- D5d: Specification of order no. 381.2090 of 8 December  
1988
- D5e: letter of Mr.Braendgaard of 11 September 1996
- D5f: letter of Mr.Braendgaard of 15 August 1996
- D5g: list of contents (pages 3,4) of a catalogue CMO  
24-26-28 Mk2 TCMO 28 Mk2 of Sabroe
- D5h: Sabroe Refrigeration A/S, Piping diagram TCMO 28  
R22 drawing number 3185-125.

Evidence D4 was submitted in the oral proceedings of  
15 October 1996 but not allowed into the proceedings as  
being less relevant than the documents submitted within

the opposition period.

Evidence D5 was also submitted after expiry of the opposition period but allowed into the proceedings as being relevant and filed in response to an amendment of the claims.

III. By an interlocutory decision delivered orally on 15 October 1996, with written reasons posted on 5 November 1996, the Opposition Division held that claim 1 as granted (main request) lacked an inventive step in view of documents D1 and D2 and that there were no grounds of opposition to the maintenance of the patent in amended form on the basis of claim 1 according to the first auxiliary request received together with the second, third and fourth auxiliary requests on 9 September 1996; Claim 1 of the first auxiliary request corresponded claim 1 as granted but drafted in the one-part form with the words "characterised in that" replaced by "whereby" and completed as follows:

"1.15 ...and said fluid line (36, 42) is arranged to conduct fluid directly from said outlet (20) of said condenser (16) to said valve (38), from said valve to said orifice (40) and from said orifice (40) to an injection port opening into said compressor (10)."

It was stated in that decision that the amended claim 1 met the requirements of novelty and inventive step because the feature concerning the direct conduction of the fluid was not considered obvious in view of the available prior art.

IV. Appeals were lodged against the decision of the Opposition Division by the opponent (appellant I) and the patentee (appellant II).

Appellant I submitted with his statement of grounds of appeal evidence of another prior use designated as documents D5\* comprising:

- D5\* Evidence concerning the public availability of a piping diagram TCM0 28 R12-22-502-717 according to drawing No. 4849-065 and the delivery of a compressor configured according to this piping diagram to Inham Refrigeration B.V. 3300 A.J Dordrecht, Holland, comprising:
- D5\*h Piping diagram TCM0 28 of Sabroe Refrigeration A/S" with drawing No. 4849-065;
- D5\*i Letter from Mr Braendgaard of 25 October 1996;
- D5\*j Delivery documents of a compressor with series No. 87615 to Inham Refrigeration B.V. 3300 A.J. Dordrecht, Holland, dated 22 October 1988;
- D5\*k Specification of the compressor TCM0 28 with the serial No. 87615, dated from 27 September 1988 with reference to the drawings No. 4849-065;
- ..D5\*l Invoice from Sabroe Products of 20 October 1988 for the delivery of the compressor 87615;
- D5\*m Delivery documents from Inham refrigeration b.v. of 31 October 1988 referring to the delivery of compressor 87615 to their customer H. TOES 8.V..

The appellants filed responses to the respective grounds of appeal.

The Board issued a communication pursuant to Article 11(2) of the rules of procedure of the Boards of Appeal, setting out the issues to be discussed during the oral proceedings to be held on 29 September 1999 in which the appellants specified their requests as follows:

The appellant I (opponent) requested that the decision under appeal be set aside and that the patent be revoked.

The appellant II (patentee) requested that the decision under appeal be set aside and that the European patent be maintained,

- (1) as granted (main request),
- (2) as amended before the Opposition Division on 5 November 1996 (first auxiliary request),
- (3) on the basis of one of three other auxiliary requests filed with letter dated 6 September 1996, (second, third and fourth auxiliary requests).

V. The arguments of appellant I against maintenance of the patent on the basis of claim 1 as amended can be summarised as follows:

- (i) Inventive step of claim 1 as amended with regard to documents D1, D2 and D3:

Document D3 disclosed in the description of the prior art of the patent specification being less relevant than document D1 does not need to be involved in the assessment of the inventive step.

Reference is made to the submission of 8 December 1994 explaining in point 1.1 that features 1.1 to 1.10 and 1.12 according to the feature analysis of claim 1 are known from document D1, in point 1.2 that features 1.5, 1.7 and 1.10 to 1.14 are known from D2 and in point 1.3 that features 1.1 to 1.14 are obvious in view of the combination of D1 with D2 or D2 with D1.

It is held, contrary to paragraph 1, page 11 of the decision under appeal, that documents D1 and D2 reveal feature 1.15 as well when the wording of the amended claim 1 is interpreted in the light of the whole description of the patent in suit.

The consideration of the first instance put forward in paragraph 2, page 10 of its decision that "injection port must be at the operating part of the compressor, the term "compressor" is understood to mean this operating part, as compared with other components of the compressor such as the compressor motor" contradicts the disclosure of the present patent specification in column 3, lines 43 to 46 stating that "as best seen with reference to Figures 2 through 4 compressor 10 is of the semi-hermetic

reciprocating piston type and includes a housing 44".

This means that the term "compressor" covers the compressor of D2, the electric motor of which is cooled by refrigerant gas in the same manner as according to the present invention.

Similarly, the term "compressor" covers the compressor of D1 showing that refrigerant gas flows first through the motor chamber and then via the fluid line 84 to the pressure chamber of the compression chamber.

Since feature 1.15 states that the fluid line is arranged to conduct fluid to an injection port opening into the compressor it follows from this wording that all possibilities are open to arrange the injection port opening somewhere between the suction inlet 50 (Figure 2) and cylinders 88, 90 (Figure 7).

Feature 1.15 is thus known from document D1 and/or from D2 and the combination of D1 and D2 thus reveals all features 1.1 to 1.15 of claim 1 as amended.

- (ii) Inventive step of claim 1 as amended with regard to documents D5 to D5h and D2:

As recognised in the 2nd paragraph at page 9 of the contested decision document D5 at least implicitly discloses features 1.1 to 1.4.

Furthermore, the first instance has agreed that the drawing according to document D5a discloses a device which avoids the overheating of the compressor. This device comprises a fluid line leading from a liquid vessel via different valves to the injection valve TEAT 20-8 (cf. reference sign "1" in D5a), further from valve 1 through an intercooler to a point IP of the compressor in order to inject liquid refrigerant directly into the compressor for cooling of the same. The injection valve 1 (TEAT 20-8) is controlled by a sensor which is within the high pressure section (HP) of the compressor, namely in the outlet chamber of the compressor and thus in the current of compressed gas. Since this sensor directly controls the valve 1 (TEAT 20-8) which is able to close the flow of fluid through said fluid line, features 1.5 to 1.10 and 1.12 are also known from D5.

From the combination of the prior art teaching according to document D5 with the features of document D2, the latter disclosing the features 1.1 to 1.5, 1.7, 1.10 to 1.14 and also, as explained in point V(i) above, the feature 1.15, all features 1.1 to 1.15 of claim 1 are disclosed.

In summary, the subject-matter of claim 1 as amended lacks inventive step in the light of the disclosure of the combination of documents D5 and D2.

(iii) Inventive step of claim 1 as amended with regard

to documents D5\* to D5\*m, D1 and D2:

Since the relevance of documents D5 to D5h to claim 1 as amended has not been admitted by the first instance a reference is now made to documents D5\* to D5\*m, in particular to D5\*h.

The features 1.5 to 1.10 and 1.12 are known from drawing D5\*h showing a fluid line leading fluid directly from the outlet of the "liquid vessel 4L", to the injection valve "TEAT" and further to the inlet port IP of the compressor.

The combination of the teaching of the prior art according to D5\*, particularly D5\*h with the teaching of document D2, the latter comprising features 1.1 to 1.5, 1.7 and 1.10 to 1.15, reveals that the feature-combination claimed in claim 1 as amended is obvious.

VI.1 The arguments of appellant II regarding his appeal against the decision to revoke the patent with claim 1 as granted are as follows:

- (i) The Opposition Division based its decision on the finding that claim 1 as granted lacked inventive step having regard to the combination of D1 and D2.
- (ii) Applying Article 69 EPC and the protocol thereto to claim 1 as granted it follows that the claim is directed to an injection line for directly injecting fluid from the condenser outlet into the compressor under the control of the valve

and orifice arrangement.

Claim 1 does not extend to arrangements such as those of D1 where the incoming fluid is first used to cool the motor, and indeed is mixed with vapour from an economiser.

Nor does claim 1 relate to the arrangement of D2 where the refrigerant fluid is injected into the evaporated fluid prior to the evaporated fluid entering the compressor housing, and the combined fluid, on entering the housing, is used to cool the windings of the electric motor - reference is made to column 1, lines 49 to 52 of D2.

The decision on appeal was wrong in its finding that claim 1 as granted covered the admixture of fluid from the condenser outlet with other fluid prior to injection of the fluid mixture into the operative part of the compressor.

- (iii) The person skilled in the art has no incentive to combine the teachings of D1 and D2 in the manner suggested in the decision of the first instance. Rejection of claim 1 as granted relies upon a combination of features selected from D1 and D2 with the benefit of hindsight but without any justification as to why such individual features should be combined whilst ignoring the essential teachings of D1 and D2.

VI.2 The appellant II's comments on the appellant I's appeal against the maintenance of the patent on the basis of

the amended claim 1 can be summarised as follows:

(i) **Inventive step: D1 and D2**

For reasons put forward in point VI.1.(iii) above the person skilled in the art has no incentive, absent knowledge of the present invention, to combine selective features of the teachings of D1 and D2 and so arrive at an arrangement within the amended claims of the opposed patent.

(ii) **Prior use**

The alleged prior use according to documents D5 to D5h does not disclose the additional features of claim 1 as amended and cannot be considered as relevant to said claim.

It is submitted that:

- the allegations of prior use are not prejudicial to inventive step of claim 1 as granted or claim 1 as amended;

- the allegation of prior use evidence by D5 to D5h should not have been admitted into the opposition proceedings.

As to appellant I's allegation of further prior use on the basis of documents D5\* to D5\*m introduced for the first time on appeal, it is submitted that:

- said new alleged prior use is not prejudicial to inventive step of claim 1 as granted or claim 1 as amended;

- this new allegation of prior use should not be admitted into the proceedings.

(iii) **Admission of documents D5 to D5h and D5\* to D\*5m concerning the alleged prior use (Article 114(2) EPC)**

**D5 documents:**

Documents D5 to D5h (further documents D5) were first considered by the Opposition Division when considering the claims as amended. The Opposition Division considered that documents D5 provided in support of the alleged prior use did not demonstrate a disclosure which was prejudicial to patentability of the claims as amended. Therefore, the Opposition Division should have refused to admit the D5 documents into the proceedings.

**D5\* documents**

D5\* documents represent a new ground of opposition based on a new allegation of prior use by supply of a different compressor arrangement to a different customer in Holland.

The appellant I should have presented a properly substantiated ground of opposition based on the alleged prior use within the 9 month opposition

period. The appellant I failed to do so.

Apart from that, it is totally unclear what is made available to the public by the piping diagram at D5\*h.

Therefore, it is objected to the admission of the D5\* documents into the appeal procedure.

### **Reasons for the Decision**

1. The appeals are admissible.
2. *Maintenance of the patent as granted (main request of the appellant-patentee)*
  - 2.1 The invention

The patent specification as a whole teaches that the invention relates generally to refrigeration systems incorporating means to prevent overheating of the compressor by selectively injecting liquid refrigerant into the compressor, e.g. into the suction manifold or the compression chambers. The patent specification gives examples of what is meant by "refrigerant system" in the part of the description relating to Figures 1 to 6 and Figure 7, respectively. It follows from the overall patent specification, especially from Figure 5 and the corresponding part of the description, that the refrigeration system should be able, in response to a first predetermined temperature of the discharge gas exiting the compression chamber(s) of the compressor,

to allow liquid refrigerant exiting the condenser to flow into the suction part of the compressor, and, once the discharge temperature drops below a second predetermined temperature, to shut off said flow of liquid refrigerant until such time as the temperature of the discharge gas reaches the first predetermined temperature.

## 2.2 Cited prior art documents

### 2.2.1 Documents D1, D2 and D3 were cited within the opposition period.

Evidence D5 to D5h was submitted after expiry of the opposition period.

Evidence of prior use designated as documents D5\* to D5\*m was submitted for the first time with the Grounds of Appeal.

### 2.2.2 The examination of the evidence according to D5 to D5h (further documents D5) with a particular regard to drawing D5a reveals that they do not actually show that refrigerant fluid is supplied from the outlet of the condenser to the valve, from the valve to the orifice and from the orifice to the compressor as claimed in claim 1 but rather show a different arrangement of means in that no orifice is provided, and a solenoid valve (2) is followed downstream by the injection valve TEAT 20-8 designated with reference sign 1. Moreover, the refrigerant is supplied from a liquid vessel 4 L and the sensor for sensing temperature of compressed gas appears to be located outside the compressor housing and connected via a means designated with T to

the solenoid valve 2 positioned upstream of the injection valve 1. Since the arrangement of components and their functional relationship in the refrigeration system set out in claim 1 differs from the embodiments of the refrigeration system according to documents D5 these documents lack relevance to the subject-matter of claim 1 and consequently do not anticipate said claim.

The Board has considered the teaching of the evidence according to documents D5\* to D5\*m (further documents D5\*), submitted during the appeal procedure, in order to determine their relevance, namely their evidential weight compared with that of the documents filed in time, and has found that none of them was relevant in the above sense.

For all these reasons the alleged prior uses according to documents D5 and D5\* are of no relevance to the decision to be taken in respect of the contested patent; since the prior use claims based on said documents were not submitted in due time, they will be disregarded pursuant to Article 114(2) EPC, and so are not taken into account when assessing the patentability of the contested patent.

2.2.3 Since evidence D4 was not allowed into the proceedings before the first instance as being less relevant than the documents submitted in time and the appellants did not develop any arguments on the basis of this evidence either, only documents D1, D2 and D3 will be taken into account in the appeal procedure.

### 2.3 Novelty

After examination of the cited prior art, the Board has concluded that the subject-matter of claim 1 is novel. Since novelty has never been disputed, there is no need for further detailed substantiation on this matter.

### 2.4 Inventive step

2.4.1 According to the introductory part of the patent specification, cf. column 1, line 25 ff, prior refrigeration systems utilised capillary tubes or thermal expansion valves to control the fluid injection. Such systems have been very inefficient since the thermal expansion valves were prone to leaking during periods when such injection cooling was not needed. This leakage could result in flooding of the compressor. Additionally, when the compressor was shut down, the high pressure liquid could migrate through these expansion valves, thereby resulting in slugging of the compressor upon startup.

Typical of such a prior art system is the one illustrated in US-A-3 913 346 (further document D1) which is concerned with maintenance of a limited continuous flow of refrigerant to the motor housing in order to cool the driving motor. The liquid level in the motor compartment 34 is controlled by the placement of passage 86. D1 shows two inputs to the valve 110, designed as TXV-thermal expansion valve, exerting opposite effects, namely the temperature input from the module 112 and the pressure input from the pressure line 116 by which a superheat differential may be maintained (cf. column 8, lines 59 to 67).

2.4.2 Starting from D1 the objective technical problem faced by the inventor was to overcome the above disadvantages, in particular to achieve more accurate indication of the compressor heating, to prevent leakage of high pressure liquid during periods when cooling is not required and to provide for maximum flow rate in order to accommodate the cooling requirements while still avoiding flooding of the compressor.

2.4.3 The Board is satisfied that the problem is solved by the combination of features which distinguish the present invention from D1 and which are set out in claim 1 according to which means for preventing overheating of the compressor comprise a fluid line connected between the outlet of the condenser and said compressor and control means comprising a positively acting control valve capable of shutting off the flow of fluid through said fluid line and an orifice provided between the valve and the compressor sized to provide a pressure drop thereacross when the valve is open to limit fluid flow through the fluid line thereby to inhibit flooding of the compressor.

2.4.4 After examination of documents D1 and D2, relied on in the impugned decision and by the appellant-opponent, the Board has come to the conclusion that neither of these references destroy alone or in combination either with each other or with documents D the patentability of claim 1 as granted.

2.4.5 Contrary to the opinion of the appellant-opponent referring to column 3, lines 43 to 46 of the patent specification and asserting that according to the patent in suit the refrigerant fluid flows from the

condenser to the semi-hermetic compressor housing and thus in a similar way to that in D1, the Board would observe that the passage of the patent specification following the one referred to above, namely column 3, line 46 ff, describes the division of the compressor housing into a motor chamber, a suction manifold, the compression mechanism and a discharge chamber and thus reveals that according to the invention in suit the refrigerant fluid flows via the fluid line from the condenser outlet to the compressor, which in the context of the patent specification includes both the operative compression mechanism i.e. compression chambers and the suction manifold. Only in this way will the compressor, as opposed to the motor, be cooled. The Board would also refer in this respect to the particular embodiments and to the reference to injection of the cooling fluid into the suction manifold and compression chamber in column 1, lines 6 and 7, and column 2, lines 16 to 18 and 32 to 34 of the contested patent.

- 2.4.6 According to D1 the electric motor housing is hermetically sealed from the screw compressor and ambient, and the screw compressor housing is provided with a liquid refrigerant injection or bleed port opening to a closed screw compressor thread at a pressure intermediate of compressor suction and discharge which determines the pressure within the motor housing. High pressure liquid refrigerant bled from the condenser enters initially the hermetically sealed motor casing and rises to the level of the peripheral gap between the electric rotor and stator and is maintained at that level by the liquid refrigerant being picked up as result of the rotor

rotation and splashed against the stator for motor cooling by resultant vaporization. A fluid passage leads from the motor casing at the liquid level, normally defined by the gap position between the stator and rotor, to the bleed port to feed some of the liquid refrigerant to the closed threads for cooling the screw compressor by vaporization thereof during compression depending on the level of liquid refrigerant within the motor housing. D1 is thus not concerned with a fast, accurate and positive shutting off of refrigerant fluid to the compressing parts of the compressor.

2.4.7 In the same way, D2 is also primarily concerned with ensuring proper cooling of the drive motor. According to D2 cooling capacity is controlled by throttling the flow of refrigerant from the evaporator (18) to the compressor (12). However when refrigerant is throttled (by valve 30) prior to entering the compressor assembly, the refrigerant may be unable sufficiently to cool the motor windings, causing overheating thereof. This problem is solved in D2 by providing a bleed line 40 to provide additional flow to the suction line (not to the compressor itself) during periods in which normal flow through the suction line from the evaporator is restricted by valve 30. D2 controls the supply of fluid from the condenser to suction line 24 via bypass line 40 in response to the temperature of the air flow entering or exiting **the evaporator 18**. The same parameter controls the flow rate of refrigerant from the evaporator 18 to the compressor via valve 30. The reason for operating both valve 30 and valve 42 on the basis of the same parameter is to provide that once a predetermined minimum flow rate through 30 is reached, valve 42 is opened to allow refrigerant via

line 40 to be directed to the compressor assembly. The feature, that the control of closure of valve 30 leads also to opening of valve 42, is an essential feature of D2. This essential feature of the teaching of D2 requires a sensor that will not be affected by diversion of fluid via line 40. This essential feature could not be maintained on the basis of a sensor for sensing temperature of the compressed gas in the discharge chamber of the compressor. The temperature of the gas in the discharge chamber of the compressor would not be suitable for both controlling the throttling action of valve 30 and the opening of valve 42, contrary to the primary teaching of D2.

2.4.8 In the refrigeration system according to the embodiments shown in document D3 the thermal sensor is located outside the discharge chamber of the compressor and means for preventing overheating of the compressor are equipped with a thermostatic control valve. This system thus suffers from the disadvantages specified in the introductory part of the patent specification in suit.

2.4.9 In documents D1, D2 and D3 the primary teaching is incompatible with the invention of the patent in suit. The appellant-opponent has nonetheless sought to identify technical problems based on D1 and D2 and to suggest solutions said to fall within claim 1 of the patent in suit. As set out above, D1 and D2 do not contain any indications that would prompt the skilled person to modify or adapt their teaching, while still taking account of the teaching, so as to arrive at something falling within terms of the claims, thus achieving what the invention achieves.

Accordingly, the Board has reached the conclusion that the subject-matter of claim 1 as granted is novel and involves an inventive step as required by Articles 54 and 56 EPC and the claim is therefore patentable. The same applies to claims 2 to 12 inclusive, which relate to further modification of the refrigerant system within the scope of claim 1.

3. Having allowed the appellant-patentee's main request, the Board does not need to consider the auxiliary requests.

### **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. T. Wilson