

Publication in the Official Journal Yes / No

File Number: T 96/90 - 3.2.3

Application No.: 84 630 213.1

Publication No.: 0 148 108

Title of invention: Energy efficient air conditioning system utilizing a variable speed compressor and integrally-related expansion valves

Classification: F25B 49/00; F25B 41/06

D E C I S I O N

of 12 June 1991

Applicant: Liebert Corporation

Headword: Air conditioning system/LIEBERT

EPC Article 56

Keyword: "Inventive step (no)"

Headnote



Case Number : T 96/90 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 12 June 1991

Appellant : Liebert Corporation
1050 Dearborn Drive
P.O. Box 29186
Columbus, Ohio 43229 (US)

Representative : Waxweiler, Jean et al.,
Office Dennemeyer S.à.r.l.
P.O. Box 1502
L-1015 Luxembourg (LU)

Decision under appeal : Decision of Examining Division 2.3.01.074 of the
European Patent Office dated 10 August 1989
refusing European patent application
No. 84 630 213.1 pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : C.T. Wilson
Members : H. Andrá
W. Moser

Summary of Facts and Submissions

I. European patent application No. 84 630 213.1 filed on 24 December 1984 and published on 10 July 1985 (publication No. 0 148 108), was refused by decision dated 10 August 1989. The reason given for the refusal was that the subject-matter of independent Claims 1, 6 and 13 received on 26 May 1989 did not involve an inventive step having regard to the following documents:

US-A-4 257 238 (D1)

US-A-3 977 205 (D2)

US-A-2 350 408 (D3)

US-A-3 735 603 (D4)

II. The Appellant lodged an appeal against this decision on 10 October 1989, filing an auxiliary request for oral proceedings. The appeal fee was duly paid on 9 October 1989. On 13 December 1989 the Appellant filed a statement of grounds together with a new set of Claims 1 to 8 and six replacement sheets of the description by telefax, confirmed by letter received on 19 December 1989.

III. The valid independent Claims 1 and 4 read as follows:

"1. A method for maintaining a body which expresses a heat load, at a desired set point selected from temperature, humidity, or both, by a refrigeration system, i.e. an air-conditioning system, of the type having a refrigerant which sequentially flows through compressor means (11) which compresses vaporous refrigerant supplied from evaporator means (23), condenser means (15) which is subject to variable condenser temperature and which condenses refrigerant circulated from said compressor means (11), expansion means (19) which expand said liquid refrigerant from said condenser means (15), and evaporator

means (23) which is in heat exchange relationship with a fluid for its cooling, said evaporator means (23) supplying said refrigerant to said compressor means (11), said cooled fluid directly or indirectly being in heat exchange relationship with said body for maintaining said set point, comprising the steps of:

sensing a condition of said body selected from temperature, humidity, or both;

varying the mass flow of the refrigerant with variable speed compressor means (11) responsive to said sensed condition for maintaining said set point constant; and

also varying the mass flow of the refrigerant with variable speed compressor means (11) responsive in the presence of varying condenser means temperature wherein the mass flow of refrigerant is attenuated at lower condenser means temperature, characterized by the steps of:

providing expansion means (19) adapted to maintain constant the set point by maintaining an adequate mass flow of refrigerant to the evaporator means and by reducing the pressure of the flow of refrigerant thereacross in the presence of varying mass flow and low head pressures as they occur at low winter time temperatures, the flow of refrigerant from the condensing means being not constrained to be a predetermined ratio of liquid-to-gaseous refrigerant and the expansion means not being responsive to the maintaining a predetermined evaporator temperature.

4. An air-conditioning system of the type having a refrigerant which sequentially flows through compressor means (11) which compresses vaporous refrigerant supplied by evaporator means (23), condenser means (15) which is in heat exchange relationship with outdoor air for condensing

refrigerant circulated from said compressor means (11), expansion means (19) which expands liquid refrigerant from said condenser means (15), and evaporator means (23) which is in contact selected from direct or indirect heat exchange relationship with air in a confined space for maintaining said confined space air at a desired set point selected from temperature, humidity, or both, said evaporator means (23) supplying said refrigerant to said compressor means (11), comprising:

sensing means for sensing a condition selected from the temperature, the humidity, or both of said space; and

variable speed compressor means (11) responsive to said sensed condition for maintaining said set point, and being responsive in the presence of varying outdoor air temperature for attenuating refrigerant mass flow corresponding to lower outdoor air temperature, characterized in that:

the expansion means (19) is adapted to maintain constant the set point space temperature by maintaining an adequate mass flow of refrigerant to the evaporator means and by reducing the pressure of the flow of refrigerant thereacross in the presence of varying mass flow and low head pressures as they occur at low winter time temperatures, the flow of refrigerant from the condensing means being not constrained to be a predetermined ratio of liquid-to-gaseous refrigerant and the expansion means not being responsive to the maintaining a predetermined evaporator temperature.

- IV. In a communication pursuant to Article 11(2) of the Rules of Procedure of the Boards of Appeal dated 28 February 1991, the Board set out its opinion having regard to the independent Claims 1 and 4 and came to the provisional finding that the subject-matter of these claims would not appear to involve an inventive step in the light of the prior art known from D1 to D4.

V. In oral proceedings held on 12 June 1991, the Appellant maintained his request that the decision under appeal be set aside and the patent be granted on the basis of the Claims 1 to 8 filed on 19 December 1989; pages 1, 3, 4, 6, 12 and 15 of the description filed on 19 December 1989; pages 2, 5, 7 to 11, 13, 14, 16 and 17 of the description and sheets 1/4 to 4/4 of the drawings as originally filed.

VI. In writing and during oral proceedings the Appellant submitted the following arguments:

(i) D1 relates to a heat pump which serves to cool a room and to maintain the temperature at a desired set point when the outdoor temperature is above a given temperature. From a predetermined lower temperature the system has to heat the room to keep the temperature at the desired set point. The system will never have to operate at winter time temperatures in the cooling mode.

(ii) The refrigeration system known from D2 uses a constant capacity compressor and provides a two-step expansion means with the second step being turned on only when the outdoor temperature falls below a given value. In view of the constant capacity compressor resulting in a constant mass flow and the use of a variable capacity compressor in a heat pump system operating in a cooling mode and a heating mode, it cannot be said that the combined consideration of D1 and D2 suggests in a method and system of refrigeration and air-conditioning according to the preambles of the independent claims of the invention to combine an expansion means of the type as claimed with a variable capacity compressor.

(iii) The system disclosed in D3 is only used for cooling a room, it will not therefore have to operate at winter time temperatures, i.e. when operating, its condenser will never experience low winter time temperatures. For this reason, the expansion means arrangement of D3 cannot be considered as giving to the expert the hint to use an expansion means of the type claimed in combination with a variable capacity compressor in an air-conditioning system of the type described in the application.

(iv) The invention comprises particular features not disclosed in the prior art. Claims 5 and 6 (Figures 3 and 4 of the drawings), respectively disclose the arrangement of a pressure regulator valve and an expansion valve in series and the arrangement of a primary and a secondary expansion valve connected in parallel by a refrigerant line from the condenser, the secondary valve being of greater capacity than the primary valve, respectively. An alternative parallel valving arrangement comprising a solenoid actuated valve with a capillary tube means and a thermal expansion valve is shown in Figure 5, in which arrangement some of the refrigerant flow is permitted to by-pass the expansion valve.

These embodiments show that the invention operates differently from the cited prior art.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC. It is admissible.

2. **Amendments**

- 2.1 The pre-characterising portion of Claim 1 is a combination of features disclosed in original Claims 1, 3 and 7.

The features according to the characterising portion of Claim 1 that the expansion means is adapted to maintain constant the set point by maintaining an adequate mass flow of refrigerant to the evaporator means and by reducing the pressure of the flow of refrigerant thereacross in the presence of varying mass flow and low head pressures as they occur at low winter time temperatures have a basis on page 6, second paragraph, and on page 12, second paragraph of the original description.

The further features of Claim 1 that the flow of refrigerant from the condensing means is not constrained to be a predetermined ratio of liquid-to-gaseous refrigerant and that the expansion means is not responsive to maintaining a predetermined evaporator temperature are based upon page 8, lines 28 to 34, and page 11, lines 10 to 15 respectively, of the original description.

- 2.2 The first portion of Claim 4 concerning an air-conditioning system is based upon features of original Claims 6 and 7.

The features of the characterising portion of Claim 4 correspond in substance with those of the characterising portion of Claim 1 and the observations made in respect of the second portion of Claim 1 apply equally to the second portion of Claim 4.

- 2.3 Claims 2, 3 and 5 correspond in substance to original Claims 2, 3 and 10, respectively.

Claim 6 is based upon original Claim 11 and on page 12, paragraph 2 of the original description.

Claim 7 is based upon page 12, lines 23 to 26 of the original description and Claim 8 contains a combination of features disclosed in original Claims 4 and 12.

- 2.4 The claims are not, therefore, objectionable under Article 123(2) EPC.

3. **Novelty**

After examination of the documents revealed by the search report, the Board is satisfied that none of them discloses a method or a system comprising all the steps and features stated in claims 1 and 4 respectively. On the other hand, as novelty has never been disputed by the Examining Division there is no need for further detailed substantiation of this matter.

Hence, these claims are novel in the sense of Article 54 EPC.

4. **Inventive step**

- 4.1 The closest prior art is reflected by D1, which document was also acknowledged by the Appellant to reflect the relevant prior art suitable for delimiting the independent Claims 1 and 4, respectively. This citation discloses the features of the method and system according to the pre-characterising portions of Claims 1 and 4, respectively.

- 4.2 The subject-matter of Claim 1 and Claim 4, respectively, differs from the method and system described in D1 by the features of the characterising portion of Claim 1 and Claim 4, respectively.

From a comparison of the effects obtained from D1 with the effects obtained from the subject-matter of the independent claims, it arises that the inherent problem has to be seen in modifying the known method and system such that it operates efficiently in winter-time conditions, i.e. at low outdoor temperature and consequently low condenser or head pressure.

The above deficiency of the system known from D1, i.e. an inefficient operation in winter time conditions, will be found automatically when using the known system under such conditions. The skilled person would therefore immediately recognise the inherent problem such that no contribution to inventive step can be seen in the perception of the problem.

- 4.3 The skilled person faced with the inherent problem would be expected to take account of the refrigeration system disclosed in D2 since this citation deals with the same problem (cf. column 1, lines 18 to 45, and column 2, lines 41 to 47, in D2).

D2 describes a refrigeration system designed for maintaining constant temperature and humidity conditions (cf. column 1, first paragraph), the use of expansion means being disclosed which is adapted to maintain an adequate refrigerant mass flow to the evaporator and to reduce the pressure of the flow of refrigerant thereacross in the presence of varying refrigerant mass flow and low head pressures (cf. column 2, lines 36 to 47, and column 2, line 66, to column 3, line 5). The system has

been designed with expansion means in the form of a dual distribution device adapted to maintain a normal superheat and to meter the proper amount of refrigerant into the evaporator to satisfy the heat load at a relatively low high-side pressure caused by low outdoor temperature (cf. column 4, lines 13 to 18); therefore, the flow of refrigerant from the condensing means is not constrained to represent a predetermined ratio of liquid-to-gaseous refrigerant and the expansion means is not responsive to maintaining a predetermined evaporator temperature.

The person skilled in the art, endeavouring to solve this same problem, would replace the expansion means of D1 by that of D2 having the above-cited characteristics and would thus arrive at the subject-matter of Claims 1 and 4, respectively. He would be motivated to proceed in this manner because he would recognise due to the correspondence of the underlying problems in the refrigeration systems of D2 and of the invention that the expansion means disclosed in D2 is appropriate for solving his problem since it is used in the citation for the same purpose, i.e. to obtain a more efficient operation of the refrigeration system at low condensing pressures.

Such a conclusion is also supported by the fact that refrigeration systems having variable mass flow of the refrigerant due to variable compressor capacity and having expansion means adapted for operation under wide variations of head pressure and mass flow are already known from D3 or D4. The solution according to the characterising portion of Claims 1 and 4, respectively, as disclosed in D2, is applicable independently of the question whether the compressor of the refrigeration system is of the variable speed or of the constant capacity type. In accordance with a physical law, pressure decrease in the condenser depends on the temperature to

which the condenser is subjected. The measure to be taken for safeguarding an efficient operation of the refrigeration system under reduced condenser pressure, namely to provide the type of expansion means claimed in Claims 1 and 4, respectively, will be successful in application to refrigeration systems with any type of compressor as long as an appropriate value of pressure drop across the expansion valve and an adequate refrigerant mass flow is maintained. Appropriate values of refrigerant pressure drop and mass flow can, however, basically be arrived at both with a constant capacity compressor and a variable speed compressor subject to the use of expansion means which are adapted to the values of pressure drop and mass flow required for maintaining constant the temperature and/or humidity set point(s).

The Board cannot, therefore, see that there exists any risk or prejudice which might restrain the skilled person from applying the expansion means provided for in D2 to a refrigeration system of the type having variable speed compressor means as known from D1.

4.4 The further arguments submitted by the Appellant in support of an inventive step are not sufficiently convincing either to reverse the above conclusion of obviousness.

(a) The Appellant asserts that the refrigeration system known from D1 will never have to operate at winter time temperatures in the cooling mode. However, this submission fails to recognise that the control system of D1 relates generally to refrigeration systems and has specific applications in air-conditioning systems and in reversible heat-pump systems operated in the cooling mode for cooling confined spaces such as dwellings and office

buildings (cf. column 1, paragraph 1 of D1). In such applications, the heat load on the refrigeration system may be substantially the same in summer or winter (cf. for example D2, column 1, paragraph 1). It is the user of such a system who determines the mode of operation by selecting the appropriate values of temperature and/or humidity for the space to be air-conditioned. The question whether the system of D1 will be required to operate at winter-time temperatures in the cooling mode, depends therefore primarily on the heat load developed by the body or space to be cooled.

Besides, D1 reflects the relevant prior art as acknowledged also by the Appellant from which art according to the established jurisprudence of the Boards of Appeal the objective problem (see point 4.2 above) has to be derived. Since it is considered to be a disadvantage that the system of D1 does not operate efficiently in winter-time conditions, the question whether this system will have to operate at winter-time conditions in the cooling mode is irrelevant to the issue of inventive step. The only question to be answered for this issue is whether it was obvious for the skilled person to transfer the teaching of D2 to the refrigeration system of D1 and arrive thereby at the claimed invention.

- (b) Having regard to the further statement of the Appellant that according to some of the dependent claims and the figures of the drawings it would be clearly shown that the invention operates in a different manner as compared to the prior art, it was pointed out in the oral proceedings that none of the independent claims is restricted to any of these

particular embodiments. The Appellant cannot therefore rely on such arguments to support the presence of an inventive step in the subject-matter of an independent claim devoid of such measures and these arguments are therefore irrelevant.

- 4.5 For the foregoing reasons, the subject-matter of Claims 1 and 4, respectively, lacks an inventive step as required by Article 56 EPC and cannot, therefore, be allowed having regard to Article 52(1) EPC.
- 5. The other claims 2, 3 and 5 to 8 must share the fate of claims 1 and 4 since they are dependent on these claims.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:



C.T. Wilson