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D E C I S I O N
of 19 June 1996

Case Number: T 0271/93 - 3.2.3
Application Number: 87306599.9
Publication Number: 0255313
IPC: F25B 39/04, F28F 9/02, F28D 1/053

Language of the proceedings: EN

Title of invention:
Condenser

Patentee:
Showa Aluminum Kabushiki Kaisha

Opponent:
(01) Längerer & Reich GmbH & Co. KG
(02) Behr GmbH & Co.
(03) Valeo Thermique Moteur
(04) Zexel Corporation
(05) Thermal-Werke GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56, 84, 123

Keyword:
"Inventive step - no"

Decisions cited:
G 0001/93, T 0024/81, T 0002/83, T 0248/85

Catchword:
-



Case Number: T 0271/93 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 19 June 1996

Appellant:
(Proprietor of the patent) Showa Aluminum Kabushiki Kaisha
224, 6-cho, Kaizan-cho
Sakaishi
Osaka (JP)

Representative:
Kerr, Simonne June
European Patent Attorney
POTTS, KERR & CO.
P.O. Box 688
Ascot
Berkshire SL5 8YT (GB)

Respondents:
(Opponent 01) Längerer & Reich GmbH & Co. KG
D-70790 Filderstadt (DE)

Representative:
Kratzsch, Volkhard, Dipl.-Ing.
Patentanwalt
Postfach 90
D-73701 Esslingen (DE)

(Opponent 02) Behr GmbH & Co.
Mauserstrasse 3
D-70469 Stuttgart (DE)

Representative:
Riedel, Peter
c/o Patentanwalt
Dipl.-Ing. W. Jackisch & Partner
Menzelstrasse 40
D-70192 Stuttgart (DE)

(Opponent 03) Valeo Thermique Moteur
8 rue Louis Lormand, La Verrière
F-78320 Le Mesnil Saint-Denis (FR)

Representative:
Bezault, Jean
Cabinet Netter
40, rue Vignon
F-75009 Paris (FR)

(Opponent 04)

Zexel Corporation
23-14, Higashiikebukuro 3-chome Toshima-ku
Tokyo (JP)

Representative:

Hansen, Bernd, Dr.rer.nat.
Hoffmann, Eitle & Partner
Patentanwälte
Postfach 81 04 20
D-81904 München (DE)

(Opponent 05)

Thermal-Werke GmbH
Talhausstrasse 16
D-68766 Hockenheim (DE)

Representative:

Dr. Elisabeth Jung
Dr. Jürgen Schirdewahn
Dipl.-Ing. Claus Gernhardt
Postfach 40 14 68
D-80714 München (DE)

Decision under appeal:

Decision of the Opposition Division of the
European Patent Office posted on 12 March 1993,
revoking European patent No. 0 255 313 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: C. T. Wilson
Members: H. Andrä
M. K. S. Aúz Castro

Summary of Facts and Submissions

I. European patent application No. 87 306 599.9, filed on 27 July 1987 and published on 3 February 1988 under publication No. 0 255 313, was granted on 31 October 1990.

II. The patent was opposed by the Respondents 01 to 05 on the grounds that the subject-matter of the patent extends beyond the content of the application as filed and is not patentable within the terms of Articles 52 to 57 EPC.

In support of their requests, the Respondents referred inter alia to the following prior art:

(D1) WO-A-84/01208

(D4) US-A-2 004 390

(D18) JP-U-59-19880 (with English translation)

Furthermore, the Respondent 05 referred to a public prior use submitting technical drawings and shipment documents and offering the hearing of witnesses in support therefor.

III. The patent was revoked by a decision dated 12 March 1993 because of lack of inventive step.

IV. The Appellant (proprietor of the patent) filed an appeal against this decision on 22 March 1993 and paid the appeal fee on 6 April 1993. The Statement of Grounds of Appeal was filed on 9 July 1993.

- V. Following the Communication pursuant to Article 11(2) RPBA dated 30 October 1995 in which the Board expressed its provisional opinion oral proceedings were conducted on 19 June 1996.
- VI. At the outset of the oral proceedings, the Appellant relied on Claim 1 filed on 14 June 1996.

This claim reads as follows:

"A condenser adapted for use in a car air conditioning system in such a manner that the condenser cooperates with an evaporator compressor and other apparatuses so as to build a refrigeration cycle for the system, wherein a gaseous coolant which has been compressed by the compressor to a high temperature and high pressure is subjected to a heat exchange between it and air so as to liquify it within the condenser, the condenser comprising a pair of parallel headers (13, 14), a plurality of tubular elements (11) whose opposite ends are connected to the headers (13, 14) and fins (12) provided in air paths present between adjacent tubular elements, characterised in that each header (13, 14) comprises an aluminum pipe of circular cross-section, each tubular element (11) comprises a flat hollow aluminium tube, each tubular element (11) having one or more internal reinforcing portions which connect an upper wall of the tubular element to a lower wall thereof, the opposite ends of the tubular elements (11) being inserted into slits (15) provided in the headers (13, 14) and brazed therein so as to be liquid-tight, at least one of the headers, (13, 14) being internally divided by a fluid tight partition (20 or 21) into at least two groups of coolant passageways thereby enabling the flow of both gaseous and condensed coolant to make at least one U-turn in the header (13, 14), the first of at least two such groups being

located towards the inlet side and one other of such groups being located towards the outlet side and the effective cross-sectional areas of the passageways being progressively reduced from the inlet side to the outlet side, wherein the first such group of coolant passageways form a condensing zone and the final of said other of such groups of coolant passageways form a super-cooling zone, and being further characterised in that the condenser is so arranged that the liquid coolant is not separated from the gaseous coolant."

Following the Board's conclusion that this claim could not be admitted because of non-compliance of its subject-matter with Articles 84 and 123(2) EPC, the Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of Claim 1 filed on 14 June 1996 with the proviso that the last three lines after the word "zone" be deleted and the word "zone" be followed by a full stop, Claims 2 to 13 filed on 9 June 1992, a description yet to be adapted and Figures 1 to 14 as granted.

VII. The essential arguments brought forward by the Appellant can be summarised as follows:

The subject-matter of Claim 1 concerns a combination of features which enables a small-core, light-weight and cost-effective product to be created.

The document (D4), in particular according to the embodiment of Figure 7, teaches the separation of the liquid and gaseous phases of the coolant. The underlying object is to slow down the liquid, to increase the amount of cooling surface in contact with the liquid and to achieve thereby sub-cooling of the liquid.

Having regard to the alternative arrangement of the condenser without dam plates as referred to on page 2 of document (D4), the liquid would fall through and there would be a tendency for the condensate temperature at the end of each pass of the condenser to be higher than the vapour temperature. This would inevitably result in an inefficient condenser.

Besides, there is no pointer in document (D4) to making the condenser smaller in adaptation to the use in a car air conditioning system.

Furthermore, the citation does not teach that each header comprises an aluminum pipe of circular cross-section, that fins are provided in air paths between adjacent tubular elements and that the tubular elements are made of aluminum, have a flat configuration and comprise internal reinforcement portions.

With such a construction of the header and the tubes, a structure of low weight, least metal expenditure and highest stability is achieved, the flattened tube shape taking account of space considerations and the least wind resistance in car application. The arrangement of fins leads to a mechanical reinforcement of the condenser and an increased heat transfer between the air and the tubular elements.

The document (D18) relates to an oil cooler in which the level of the operating coolant pressure is different as compared to a condenser and the document (D1) concerns a car radiator having water cooling in which no phase change of the coolant occurs.

Due to these differences as to the structure and the operation between the invention and the above-cited prior art heat exchangers, there was no motivation at

all for the skilled man to combine the documents (D4), (D18) and (D1) and such a consideration would therefore be based on hindsight.

VIII. The Respondents requested that the appeal be dismissed. They argued essentially as follows:

The basis for assessing the question of inventive step is found in document (D4) which describes a condenser appropriate for general use.

The distinguishing features of Claim 1 in relation to the disclosure of document (D4) are all found in document (D18), except for the feature that each header is of a circular cross-section, which, however, is a routine choice for the skilled person and moreover known for example from document (D1). The subject-matter of Claim 1 thus is a mere aggregation of features in view of optimising a condenser as to strength, weight and method of assembling which does not form in any way an invention.

Reasons for the Decision

1. The appeal is admissible.

Claim 1 filed on 14 June 1996

2. *Amendments*

The amendments to Claim 1 in relation to the version as granted included inter alia the feature that the condenser is so arranged that the liquid coolant is not separated from the gaseous coolant. This statement which has to be interpreted in its general meaning excludes that in any passage of the condenser there is a separation of the liquid coolant from the gaseous coolant.

Column 4, lines 11 to 33 of the patent in suit, based upon the passage bridging pages 5 and 6 of the original description, specifies, however, that in the inlet section (A) the coolant is in its gaseous state and that in the outlet section (C) the coolant is in its liquid state, which means that, contrary to the feature in dispute, there are regions of the condenser in which either gaseous or liquid-state coolant is present and thus a separation of these phases occurs. Furthermore, as the coolant in a given pass flows from the individual tubes into the header there is at least a partial separation of the liquid and the gaseous portions since the liquid portion due to the adhesion effect clings to the header wall and is therefore at least locally separated from the gaseous portion. Additionally, the difference of the density between the gaseous and the liquid coolant portion leads, in

accordance with basic laws of physics, to the effect that gravity causes the liquid to collect in the lowermost range of the header and the tubes, respectively.

Decision G 1/93 (OJ 1994, 541) does not apply here, the feature in dispute being of a technical, physical character: it provides the technical teaching to conduct the liquid coolant in close connection with the gaseous coolant through the condenser. According to the decision however, only the addition of a non-disclosed feature which provides no technical contribution to the subject-matter of the claimed invention can be allowed.

Therefore, the Board could not admit that claim in view of Articles 123(2) and 84 EPC.

Claim 1 as presented in oral proceedings

3. *Amendments*

Claim 1 is supported essentially by the original Claims 1, 5, 6 and 14. The feature that each tubular element (11) has one or more internal reinforcing portions connecting the upper and the lower walls thereof is disclosed on page 5, paragraph 2 in combination with Figures 3 to 6 and 9 to 13 of the original description and drawings, respectively.

The feature that the opposite ends of the tubular elements (11) are brazed in the slits (15) provided in the headers is based on page 7, lines 2 to 4 of the original description where the soldering substance is described as being an AlSi alloy preferably containing 6 to 13% by weight of Si. "Soldering" is known to be a generic term which comprises "soft soldering" and "hard

soldering". The AlSi-composition of the "soldering substance" refers to a substance used for hard soldering, that is brazing, due to its relatively high melting point, in contrast to tin used for soft soldering. The skilled person concludes therefore that the term "soldered" used throughout the original application means "brazed".

The feature that the partition (20, 21) is fluid tight derives from page 7, line 22 to page 8, line 3 of the original description.

The feature that the flow of both gaseous and condensed coolant is enabled to make at least one U-turn in the header (13, 14) is supported by the flow pattern of coolant shown in Figure 8 of the original drawings which illustrates in combination with the passage bridging pages 5 and 6 of the original description that the gaseous and the condensed fractions of the coolant have a common flow channel throughout the zone of heat exchange.

The term "A condenser adapted for use in a car air conditioning system in such a manner that the condenser cooperates with an evaporator, compressor and other apparatuses..." substituted in Claim 1 for the term "A condenser for use in a car cooling system..." according to the original and the granted Claim 1 derives from page 1, paragraphs 1 and 2, of the original description in which the car cooler is described to use a high pressure gaseous coolant. A condenser is only needed with gaseous coolants under pressure which must be condensed and this applies only to refrigeration and air conditioning systems.

Claim 1 is not objectionable under Article 123(2) and (3) and complies also with Article 84 EPC.

4. *Novelty*

None of the prior art condensers discussed in the opposition and appeal proceedings comprises all the features of Claim 1 so that Claim 1 is considered to be novel within the meaning of Article 54 EPC. Since novelty was, in fact, not disputed by the Respondents, no further arguments in this respect are required.

5. *Inventive step*

5.1 As already illustrated in the communication dated 30 October 1995, the Board agrees with the opinion of the Appellant that the skilled person in the present case is a design engineer with knowledge of thermodynamics who is aware of the differences between one sort of heat exchanger and another. That is, he is an expert in the field of heat exchangers in general including also condensers for use in car air conditioning systems.

5.2 The Board considers document (D4) to describe the nearest prior art.

This citation relates to a combined condenser and sub-cooler which, though being particularly for use in connection with oil refining, is adapted "to do all work in which it is desired to condense vapour and cool the condensate" (page 1, left-hand column, lines 1 to 5). The citation addresses, therefore, the person skilled in the art of heat exchangers, in particular condensers, in general. Document (D4) describes a condenser which when appropriately sized and dimensioned in response to the predetermined design conditions is suitable for use in a car cooling system. It is commonly known that in such a system a gaseous coolant under high pressure and temperature is used.

The condenser comprises a pair of parallel headers (11, 13, 12, 14) and a plurality of tubular elements (10) whose opposite ends are connected to the headers. The headers are internally divided by fluid-tight partitions (23, 28) into at least two groups of coolant passageways thereby enabling the flow of both gaseous and condensed coolant to make at least one U-turn in the header, the first of the at least two such groups being located towards the inlet side and one other of such groups being located towards the outlet side and the effective cross-sectional areas of the passageways being progressively reduced from the inlet side to the outlet side. The groups of tubes close to the inlet form a condensing zone in which, according to the definition given in the patent in suit (column 1, lines 31 to 41), the coolant is mainly gaseous and the groups of tubes close to the outlet form a super-cooling zone in which - per definition - the coolant becomes liquid.

Further, reference is made to page 2, left-hand column, line 75, to right-hand column, line 21, of document (D4), in particular the passage: "If no sub-cooling is desired, all drainage ports may be opened or both dam plates (15, 16) may be entirely removed and the apparatus operated as a standard condenser." By the term "sub-cooling" cooling of the condensate is meant (see document (D4), page 1, left-hand column, lines 43 to 49) which does not correspond to the term "super cooling" i.e. liquifying of the coolant according to the patent in suit. Thus, the above-cited passage teaches the skilled person that if no substantial sub-

cooling of the condensate is desired the dam plates according to the condenser of Figure 1 can be entirely omitted as is the case with the condenser according to Claim 1 of the patent in suit.

5.3 According to the problem-and-solution approach consistently advocated by the Boards of Appeal, (see e.g. decisions T 24/81 (OJ EPO 1983, 133) and T 248/85 (OJ EPO 1986, 261), in order to assess the presence of an inventive step, objectivity in such assessment is, first of all, achieved by starting out from the objectively ruling state of the art, in the light of which the technical problem is determined which the invention addresses and solves. The application of this approach minimises the risk that the departments of the EPO responsible for the examination and the appeal rely on combinations of prior art documents originating from basically different technical fields. That is the assessment of inventive step is based on essentially objective criteria.

Returning to the case to be decided at present, Claim 1 differs from the disclosure of document (D4) by the following features:

- (A) Fins are provided in air paths present between adjacent tubular elements.
- (B) Each header comprises a pipe of circular cross-section and each tubular element comprises a flat hollow tube having its opposite ends inserted into slits provided in the headers.
- (C) The headers and the tubular elements are made of aluminum and brazed together.

- (D) Each tubular element has one or more internal reinforcement portion(s) which connect(s) an upper wall of the tubular element to a lower wall thereof.

Feature (A) serves the purpose of improving the heat transfer from the coolant to the cooling air and of achieving a stable condenser structure, features (B) and (C) serve the purpose of easily assembling the condenser and reducing its weight and feature (D) achieves an increased strength of the tubular elements.

The inherent problem resides, therefore, in providing a condenser suitable for use in a car cooling system which has a high efficiency of heat transfer, is easy to assemble, of compact shape and of low weight and is resistant to mechanical loads.

Such a problem arises within the normal development activities of the skilled person in the technical field of heat exchangers, since achieving a high efficiency of heat transfer and an easy-to-assemble and a low-weight structure are constant goals of the design engineer for economical reasons. Equally, ensuring a high strength of the condenser components is also a primary objective in view of a high-reliability product.

The posing of the underlying problem does not, therefore, require the presence of an inventive step.

- 5.4 The document (D18) relates to a heat exchanger, in particular to a highly pressure resistant heat exchanger being useful for the oil cooler or the like.

In air paths present between adjacent tubular elements (2) fins (4) are provided. Each header comprises a pipe of square cross-section and each tubular element comprises a flat hollow tube having its opposite ends inserted into slits (6) provided in the headers (1) (Figure 3). The headers and the tubular elements are made of aluminum and brazed together and each tubular element has several internal reinforcement portions, that is three such portions according to the embodiment depicted in Figure 3, which connect an upper wall of the tubular element to a lower wall thereof.

In search of a solution to the inherent problem of the patent in suit as outlined in section 5.3, the skilled person would take account of the disclosure of document (D18) since this citation tackles also the problem of an easy manufacture and of a highly resistant heat exchanger (see page 2, paragraph 2 of the English translation).

As the Appellant has also conceded, the construction of the headers and the tubular elements of aluminum leads to a small overall weight and the use of fins, besides increasing the heat transfer between the air and the tubular elements, takes account of stability considerations. Furthermore, the brazing together of the headers and the tubular elements enables an easy assembly of the condenser and the flattened configuration of the tubular elements with reinforcement portions connecting the respective upper and lower tube walls leads to a compact and high-strength condenser.

In expectation of these advantages, the skilled person is induced to substitute in the condenser described in document (D4) the above-cited features known from document (D18). He arrives thereby in an obvious manner

at the subject-matter of Claim 1 except for the feature that the header is of circular cross-section. A circular cross-section is, however, the basic and most commonly used shape of a fluid-conducting pipe which the skilled person will select whenever a simple manufacturing method or a minimisation of material consumption per unit of pipe flow area is required.

Moreover, a header comprising a pipe of circular cross-section is known from document (D1) relating to a car radiator assembly so that the choice of such a shape of the header does not even require closer considerations.

- 5.5 The Appellant argues that document (D18) relates to an oil cooler in which the level of the operating coolant pressure is different from that of a condenser and that therefore a combination of features of (D4) and (D18) would be based on hindsight.

This argument ignores the fact that in the assessment of the issue of inventive step it has to be examined whether the prior art or the common knowledge of the skilled person provided a suggestion of the claimed solution in order to obtain the advantageous effects arising therefrom (see decision T 2/83, OJ EPO 1984, 265). There can be no doubt that the distinguishing features (A) to (D) (see section 5.3) known from the documents (D18) and (D1), respectively, have the same advantageous effects as the corresponding features according to the patent in suit. In this context, the circumstance that Claim 1 relates to a condenser for use in a car air conditioning system whereas the documents (D18) and (D1) relate to a heat exchanger in general and a car radiator assembly, respectively, is irrelevant since the effects resulting from the cited

distinguishing features are not in causal relationship with the operation of a condenser for use in a car air conditioning system but are achieved whenever applied to a heat exchanger.

The further argument of the Appellant that there is no pointer in document (D4) to making the condenser smaller in adaptation to the use in a car does not take into account that the size of a condenser used in a car air conditioning system depends to a large extent on the cooling and heating performance required which manifestly differs considerably depending on the operation purpose of the car. Irrespective of this consideration, Claim 1 does not comprise any indication as to the performance data and size of the condenser so that the Appellant's argument is without any basis.

The Board has also examined the question whether in applying the above-cited distinguishing features, to a condenser for automotive purposes any new and unexpected effect occurred or whether any particular difficulty had to be overcome. No evidence in this direction was, however, shown by the Appellant and the Board could also not identify any such difficulty or synergistic effect resulting from such a use.

5.6 Summarising, the Board comes to the conclusion that Claim 1 can not form a basis for maintaining the patent in amended form since its subject-matter does not involve an inventive step (Article 56 EPC). Under these circumstances, it was not necessary to examine whether also other combinations of prior-art documents as forwarded by the Respondents would lead the skilled person in an obvious way to the subject-matter of Claim 1.

Order

For these reasons it is decided that:

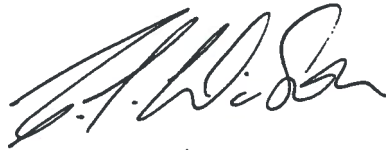
The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:



C. T. Wilson