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Datasheet for the decision of 4 September 2020

Case Number: T 0149/17 - 3.2.04

Application Number: 07765559.5

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IPC: F04B49/24

Language of the proceedings: EN

Title of invention:
RECIPROCATING COMPRESSOR INCLUDING EQUIPMENT FOR CONTINUOUS REGULATION OF THE FLOW RATE IN THE SAID COMPRESSOR

Patent Proprietor:
Dott.Ing. Mario Cozzani S.R.L.

Opponents:
Hoerbiger Wien GmbH
Burckhardt Compression AG

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no)

Decisions cited:

Catchword:

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Case Number: T 0149/17 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 4 September 2020

Appellant: (Opponent 1)	Hoerbiger Wien GmbH Seestadtstrasse 25 1220 Wien (AT)
Representative:	Patentanwälte Pinter & Weiss OG Prinz-Eugen-Straße 70 1040 Wien (AT)
Respondent: (Patent Proprietor)	Dott.Ing. Mario Cozzani S.R.L. Viale XXV Aprile, 7 19021 Arcola (IT)
Representative:	Porsia, Attilio Via Caffaro 3/2 16124 Genova (IT)
Party as of right: (Opponent 2)	Burckhardt Compression AG Im Link 5 8404 Winterthur (CH)
Representative:	Dr. Graf & Partner AG Intellectual Property Herrenacker 15 Postfach 518 8201 Schaffhausen (CH)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 7 November 2016 concerning maintenance of the European Patent No. 2032854 in amended form.**

Composition of the Board:

Chairman	A. de Vries
Members:	G. Martin Gonzalez
	C. Heath

Summary of Facts and Submissions

I. The opponent 1 lodged an appeal, received on 9 January 2017, against the interlocutory decision of the Opposition Division posted on 7 November 2016 concerning maintenance of the European Patent No. 2 032 854 in amended form, and simultaneously paid the appeal fee. The statement setting out the grounds of appeal was received on 6 March 2017.

II. Two oppositions were filed under the ground of inter alia Article 100(a) EPC for lack of inventive step. The Opposition Division held that the patent as amended met the requirements of the Convention having regard inter-alia to the following documents:

(D1) EP 0 801 227 A2.
(D14) "Der elektromechanische Ventiltrieb-Systembaustein fur zukunftige Antriebskonzepte, Teil I"; MTZ Motortechnische Zeitschrift 61 S. 826-836; 12/2000.

III. The appellant-opponent requests that the decision be set aside and the patent revoked.

The respondent-proprietor requests that the appeal be dismissed, alternatively they request maintenance of the patent in amended form according to one of first and second auxiliary requests both filed with letter of 23 March 2020.

The opponent 2, as party as of right, has not submitted any requests, nor made any substantive submissions.

IV. In preparation for oral proceedings the Board issued a communication setting out its provisional opinion on the relevant issues.

Oral proceedings before the Board were held on 4 September 2020, in the absence of the opponent 2 who announced by letter dated 29 April 2020 that they will not attend the scheduled oral proceedings.

V. Independent claim 1 of the relevant requests reads as follows:

(a) Main request

"Reciprocating compressor including equipment for continuous regulation of the flow rate thereof, provided with at least one compression chamber (1) in which is slidably inserted a piston means (101) movable with a reciprocating motion, at least one inlet valve (2) for the fluid to be compressed and at least one outlet valve (4) for the compressed fluid being provided in the said chamber, the said outlet valve (4) being connected to a storage reservoir (10) for the compressed fluid, and the said inlet valve (2) being provided with translation means (502, 512) which can act on the sealing element (302) of the said valve (2), the said translation means (502, 51 2) being movable in a direction perpendicular to the plane of the said sealing element (302), and interacting with actuator means (3, 103, 203) which are movable in the said direction with a reciprocating motion by means of suitable operating means (303, 403), the said operating means (303, 403) make it possible to control the velocity of displacement of the said actuator means (3, 103, 203) in both directions of their movement, means (42) for detecting the position of the said actuator

means (3, 103, 203), means (43) for detecting the position of the piston in the compression chamber and means (41) for detecting the pressure in the reservoir being provided, the said detection means (42, 43, 41) and the said operating means (303, 403) of the actuator means (3, 103, 203) being connected to a central processing unit (40), characterized in that said operating means of the said actuator means (3, 103, 203) are electromechanical means and comprise a rod (103) provided in its central portion with a moving element (203) which is radially projecting and magnetizable, the said moving element interacting with two solenoids (303, 403) and being placed in equilibrium between the latter, using suitable resilient loading means (213, 223), said actuator means being able to act only to maintain the inlet valve open."

(b) Auxiliary request 1

Claim 1 as in the main request.

(c) Auxiliary request 2

Claim 1 as in the main request, the last feature amended as follows (emphasis added by board to indicate modified text):

"...said actuator means being able to act on the already open sealing element (302) ~~only to maintain the inlet valve open~~.

VI. The appellant-opponent argued as follows:

Claim 1 of all requests on file lacks an inventive step over the combination of D1 and D14.

VII. The respondent-proprietor argued as follows:

The subject-matter of the main request, as well as of the first and second auxiliary requests, involves an inventive step in the light of the cited prior art.

Reasons for the Decision

1. The appeal is admissible.

2. Background

The invention is concerned with reciprocating compressors having continuous regulation of the flow rate, see patent specification paragraph [0001]. In unregulated mode (100% flow-rate), the admission or inlet valve is closed at the beginning of the compression stroke by the overpressure inside the compression chamber. The inlet valve remains closed during the compression stroke, while pressurized gas leaves the chamber through the outlet valve. Continuous regulation - also backflow control - is obtained by purposefully delaying the closure of the inlet valve at the beginning of the compression stroke. Gas, which entered the cylinder, flows back, unpressurized, through it. The quantity of returned unpressurized gas is proportional to the delay for closing the inlet valve. Thus, a corresponding reduction in gas flow rate through the pressure or outlet valve is achieved, see paragraph [0007]. The delay is obtained by a pushrod, moved by actuator means, that can keep the sealing element of the inlet valve in the open position against the overpressure closing forces. The aim of the invention is to limit the wear of the inlet valve components. The claimed compressor uses solenoid

actuator means that have a fast reaction time while also allowing control of their velocity of displacement. The pushrod can thus be controlled to initially move fairly rapidly, subsequently markedly slower before coming into contact with the sealing element, see paragraph [0024]. The corresponding shock level and valve wear is so reduced, see paragraph [0026].

3. Main request - Inventive step

The appellant-opponent contests the findings of the Opposition Division that upheld claim 1 involves an inventive step over the combination of D1 and D14.

3.1 It is undisputed that D1 discloses a continuously regulated piston compressor with hydraulic actuator means 14. It is also common ground that D1 does not disclose electro-magnetic actuation. The main contention concerns the feature that the actuator means acts only to maintain the inlet valve open. This is understood to mean that the inlet valve opens exclusively by action of pressure difference, the actuator means only acting when the valve is already open and only to delay the subsequent closure of the inlet valve. The feature thus excludes that the actuator means assists the valve opening process in any manner.

3.1.1 D1, see figure 3, and column 8, line 26, to column 9, line 4, shows typical opening characteristics of the inlet valve as a function of time, for three different control scenarios A, B and C. As explained in column 8, lines 43 to 46, the pushrod ("Abhebegreifer") of the actuator means in scenario A acts too late ("zu spät") so that the inlet valve opens exclusively by the action

of pressure difference; the pushrod thus does not intervene in the opening process. In the alternative scenarios of curves B and C, shown in figure 3, the pushrod, in contrast, acts on the valve while it is opening or during the whole opening process, see column 8, line 57 - column 9, line 34. In the scenario of curve A the actuator thus acts only to maintain the inlet valve open corresponding to the final feature of claim 1 as upheld. The Board therefore considers a piston compressor as regulated in accordance with curve A to have the most features in common with the claimed invention and to thus constitute an appropriate starting point for the assessment of inventive step. See in respect of the relevant criteria developed in jurisprudence the Case Law of the Boards of Appeal, 9th edition 2019 (CLBA) I.D.3.1. to 3.6.

3.1.2 Although the variant of curve A of D1 does not represent the path followed in D1, it nonetheless describes a typical opening sequence of a compressor, which D1 then sets out to improve, see column 9, lines 11-13 ("Die bei die konventionell ausgebildeten Saugventilen und eingangs beschriebene Untersaugungspitze..."). These lines ("... konventionell ...") indeed suggest that such an operation is not a hypothetical, untested opening sequence, but represents a conventional existing approach from which D1 departs. This is echoed in further lines 36 to 40 of column 9 which describes curve A as a concrete embodiment ("konkretem Ausführungsbeispiel"). Nor can the fact that D1 departs from this approach or teaches a better one negate the fact that D1 recognizes it as an existing, conventional one. For the same reason D1 cannot be said to "teach away" from or avoid a possible course of action (curve A) as erroneously held in the decision under appeal.

Curve A does not represent a possible or hypothetical course of action that the skilled person might have tried but for the fact that D1 dissuades them to do so. Rather, D1 discloses curve A as a mode of regulation in a piston compressor that has actually been practised.

For these reasons D1 is seen to disclose in curve A a prior art instance of a continuously regulated pressure compressor which was known to the author of D1 before the date of the D1 invention. This is reflected also in column 1, lines 39-48, describing the prior art and according to which compressors are known in which by means of a pushrod the inlet valve is held open during compression, see also d column 1, line 56 - column 2, line 19.

The Board concludes that a continuously regulated piston compressor operated according to curve A represents a separately citable instance of prior art according to Article 54(2) EPC.

3.2 Therefore, the only differences of the claimed subject-matter with respect to D1 are that the actuator is of the solenoid type and the further features of the solenoid actuator.

3.3 Compared to the hydraulic actuators of D1, solenoid actuators have a markedly reduced reaction time. Their velocity of displacement can also be controlled. It is thus possible to achieve the adequate fast actuator response for continuous regulation of the flow rate, while also limiting its end velocity before contact with the already open valve closure element and so the corresponding shock and valve wear, see paragraphs [0024] - [0026] of the specification. The corresponding

technical problem can thus be formulated as how to improve the actuator response.

3.4 In this respect, document D14 teaches solenoid actuators and controls, having the same construction as the claimed actuator, see D14 figure 5, showing both upper and lower (electro)magnets between which is arranged an anchor of the actuator with a sensor arranged above the upper magnet. D14 specifically indicates on page 836, see the paragraph bridging columns 1 and 2, that its teaching regarding solenoid actuators and control is applicable to compressor valves ("für .... Verdichterbau"). The Board further notes that it is also known to the skilled person from their common general knowledge that solenoid actuators have sufficient response times for that use. The document D14 further teaches on pages 831-832, bridging paragraph, that using the taught solenoid actuator it is possible to ensure a gentle impact of the valve and of the armature in the respective end positions by regulating the armature movement in close range of the end positions, involving feed-back of its velocity of displacement ("Um ein sanftes Aufsetzen des Ventils und des Ankers in der jeweiligen Endlage zu ermöglichen, ist eine Regelung der Ankerbewegung im Nahbereich der Endlage erforderlich... Die Regelung basiert auf einer Rückführung des Hubsignals und dessen Ableitung (Ankergeschwindigkeit) so wie des gemessenen Spulenstromes"). Thus D14 offers the same technical advantages as sought by the skilled person, who would therefore find its teachings very relevant to solve the above formulated problem. Hence the skilled person would, in the light of the teachings of D14, consider the replacement of the conventional hydraulic actuator of D1 by a solenoid actuator and control as taught by D14 as a matter of obviousness in order to improve the

actuator response and thereby achieve a more gentle end position impact and reduce wear.

3.5 The respondent-proprietor submits that D14 belongs to a different technical field and that for this reason, their teachings are not applicable in an obvious manner to the known compressor. In this respect, the Board notes that even if the advantageous use of an electromagnetic actuator is illustrated in the valve control of a diesel engine, the teachings of D14 are broader. As is evident from its title (translated as "The Electromagnetic Valve Drive - System Component for Future Actuator Concepts"), D14 is directed to the solenoid actuator and control per-se. Since D14 also explicitly indicates that its teachings are applicable to compressor valves, it is immediately evident to the skilled person that the actuator concept proposed by D1 can be applied to those other kinds of valves irrespective of the constructional details of those other types of valve. In particular, the Board sees no reason why the skilled person would not apply the teachings of D14 to a valve where the pushrod acts on the surface of the closure element (as in that of D1) instead of forming an integral part of valve (as in the example of D14). The skilled person, an engineer involved in the design of compressors with knowledge of the relevant mechanisms and control technology, understands that in carrying over the actuator concept of D14 to a compressor valve, they should not blindly apply the design and dimensions of the example of an electromagnetically actuated diesel engine injection valve. Rather, from their general knowledge it will be immediately apparent to them that actuator design and dimensions will need to be adapted to the particular application and specifications. The necessary dimensioning and adaptation to a compressor inlet valve

is within their routine design skills. Thus, for example, any application must otherwise preserve the overall regulation scheme of curve A, that is, the pushrod must act only when the valve is already open. Similarly, they will dimension the actuator, including its stroke length, to fit the requirements of a compressor inlet valve. The Board therefore does not see any impediment or incompatibility in combining the teachings of D1 and D14. The straightforward combination of those teachings - with necessary routine adaptations and dimensioning - results in the claimed subject-matter. The Board does not therefore consider that the application of the teachings in D14 to a compressor valve, as that of D1, as such, involves an inventive step.

3.6 The respondent-proprietor has also not submitted any evidence in support of their contention that the claimed use of the solenoid actuator has a bonus or surprising effect beyond the inherent technical advantages and effects of solenoid actuators as taught by D14. Nor have they substantiated their contention that the invention solves a technical problem which persons skilled in the art have been attempting to solve for a long time, or that the claimed invention otherwise fulfils a long-felt need that could indicate the presence of inventive step. Between the suggestion to apply electromagnetic actuators to compressors in D14, which was published in 2000 3 years after publication of D1, and the priority of the patent (June 2006) lie only 6 years.

3.7 The Board thus concludes that the subject-matter of claim 1 of the main request lacks an inventive step in the sense of Article 56 EPC.

4. First and second auxiliary requests

Claim 1 of the first auxiliary request is identical to that of the main request. In the second auxiliary request claim 1 is only amended to indicate: "said actuator means being able to act on the already open sealing element (302)". This amendment attempts to rephrase in clearer terms the final feature of claim 1 as upheld but otherwise does not add to it. This formulation applies equally to D1, curve A.

Since these requests fail to further differentiate the subject-matter of claim 1 from D1, the same conclusion of lack of inventive step must hold.

5. For the above reasons, the Board finds that the decision was wrong in concluding inventive step and that therefore it must be put aside. Even taking into consideration the amendments made by the respondent-proprietor, the patent and the invention to which it relates do not meet the requirement of the Convention and the patent must be revoked the patent pursuant to Article 101(3)(b) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

G. Magouliotis A. de Vries

Decision electronically authenticated