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Datasheet for the decision of 28 February 2022

Case Number: T 0862/19 - 3.2.04

Application Number: 08703945.9

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IPC: F04D29/12, F04D1/08, F16J15/34, F04D29/10, F04D7/06, F04D1/06

Language of the proceedings: EN

Title of invention:
MULTI-STAGE HIGH-PRESSURE PUMP

Patent Proprietor:
EBARA CORPORATION

Opponent:
Sulzer Management AG

Headword:

Relevant legal provisions:
EPC Art. 54(2), 56

Keyword:
Prior art documents - availability to the public
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

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Case Number: T 0862/19 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 28 February 2022

Appellant: (Opponent)	Sulzer Management AG Neuwiesenstrasse 15 8401 Winterthur (CH)
Representative:	IPS Irsch AG Langfeldstrasse 88 8500 Frauenfeld (CH)
Respondent: (Patent Proprietor)	EBARA CORPORATION 11-1, Haneda Asahi-cho Ohta-ku Tokyo 144-8510 (JP)
Representative:	Carstens, Dirk Wilhelm Wagner & Geyer Partnerschaft mbB Patent- und Rechtsanwälte Gewürzmühlstraße 5 80538 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 25 January 2019 concerning maintenance of the European Patent No. 2110558 in amended form.**

Composition of the Board:

Chairman	A. de Vries
Members:	S. Hillebrand
	T. Bokor

Summary of Facts and Submissions

I. The appeal was filed by the Opponent against the interlocutory decision of the Opposition Division finding that the patent in suit according to an amended main request (with only dependent claim 7 amended) met the requirements of the EPC.

In particular, the Opposition Division held that the subject-matter of claim 1 of the main request and which was as granted involved an inventive step.

II. In a communication pursuant to Rule 15(1) RPBA, the Board gave its preliminary opinion that it tended to confirm the findings of the Opposition Division.

III. On 28 February 2022 oral proceedings were held before the Board in the form of a videoconference with all parties attending.

IV. The Appellant (Opponent) requests that the decision under appeal be set aside, and that the patent be revoked.

The Respondent (Proprietor) requests that the appeal be dismissed, i.e. the patent be maintained in the amended form as held allowable by the Opposition Division, or alternatively, on the basis of auxiliary requests 1-4, filed with the reply to the grounds of appeal dated 4 October 2019, re-filing earlier requests.

V. The sole independent claim 1 of the main request reads as follows:
" *A multistage high-pressure pump for pressurizing a fluid, comprising:*

a rotational shaft (1);
impellers (3) secured to said rotational shaft (1);
a casing (2) configured to house said impellers (3) therein;
a mechanical seal (20);
a seal chamber (25) that houses said mechanical seal (20) therein;
an oil reservoir (30) configured to store oil therein;
an oil supply line (26) providing a communication between said oil reservoir (30) and said seal chamber (25);
an oil pump (31) configured to pressurize the oil from said oil reservoir (30) and supply the oil to said seal chamber (25);
a pressure retaining mechanism (32, 34, 35) configured to retain pressure of the oil in said seal chamber (25); and
an oil outlet line (27) for discharging the oil from said seal chamber (25),
wherein the pressure of the oil in said seal chamber (25) is kept higher than pressure of the fluid, and characterized in that said pressure retaining mechanism (32, 34, 35) includes:
a check valve (32) provided on said oil supply line (26) at a position between said oil pump (31) and said seal chamber (25);
at least one accumulator (34) located between said check valve (32) and said seal chamber (25); and
a shut-off valve (35) provided on said oil outlet line (27)."

VI. In the present decision, reference is made to the following documents:

D1: US 5 865 441

D6: P. Meuter et al: "THUNDER HORSE INJECTION PUMP",Proceedings of the twentieth international pump users symposium 2003

D7: "Burgmann Mechanical Seals Design Manual 15.4", EagleBurgmann (complete document)

D7A: "Mechanical Seals Design Manual 15.3", Burgmann (extract)

D7C: "EagleBurgmann Mechanical Seals Design Manual 15.5", EagleBurgmann (extract)

D8: EP 1 059 475 B1.

VII. The Appellant's (Opponent's) arguments can be summarised as follows:
D6 discloses as closest prior art a multistage high-pressure pump with pressurized double mechanical seals. An appropriate seal support system for this seal is known from D7, page 114 as "SPA". The combination of D6 and D7 results obviously and directly in the claimed invention.

The Respondent's (Proprietor's) arguments can be summarised as follows:
It is not proven that D6 and D7 belong to the prior art according to Article 54(2) EPC.
The pump of D6 delivers sea water. In contrast to the patent, D6 does therefore not focus on containing by all means toxic or otherwise harmful high-pressure pump media. The seal supply system of D6 is already defined by the required standard API Plan 53. There is thus neither a need, nor a motivation for resorting to the seal support systems of D7.
The cited "SPA" does moreover not comprise the claimed shut-off valve. Therefore, a combination of D6 and D7 does not lead to the subject-matter of claim 1.

Reasons for the Decision

1. The appeal is admissible.

2. **The patent and its technical background**

The patent deals with multistage high-pressure pumps, in particular with the seals sealing the pump shaft, which extends from inside the pump chamber through the pump casing to the outside. For safety reasons, these seals usually comprise a pair of seals within a chamber surrounding the pump shaft, in which a buffer or barrier fluid circulates for cooling and/or lubricating the seal surfaces. The seals are arranged in pairs and symmetrically, i.e. in a so-called face-to-face or back-to-back configuration, or in series, both having the same orientation, which is referred to as a "tandem" configuration (as illustrated e.g. in D7, page 6). If the pump delivers a hazardous or toxic medium, the fluid is often a barrier fluid, i.e. pressurized above the pressure prevailing in the pump chamber, in order to contain the pump medium within the pump chamber (see paragraphs [0006] and [0007] of the patent). In the multistage pump of the patent, oil is used as barrier fluid. In order to maintain the oil pressure even in case of malfunctioning components of the oil circuit, such as a circulation pump, the invention according to granted claim 1 (maintained by the Opposition Division) proposes an arrangement of an accumulator containing pressurized oil as well as a check and a shut-off valve in the oil circuit.

3. **Documents D6 and D7 - Public availability**

3.1 In its communication, the Board gave the following preliminary opinion with regard to D6:
"*D6 is part of the "Proceedings of the Twentieth International Pump Users Symposium 2003", see pages 2, 4, 6... - 18. The Opposition Division confirmed the publication of the proceedings in 2003 with a web search (cf. section 2.2 of the impugned decision). As held by the Opposition Division, the Board sees no reason to doubt that D6 was made available to the public before the priority date of the patent in January 2007 and belongs thus to the prior art as defined in Article 54(2) EPC.*"

Since the Respondent did not further comment on this opinion in writing or during oral proceedings, the Board sees no reason to change it.

3.2 The Respondent questioned public availability of D7 inter alia because only extracts had been provided. Thereupon the Appellant provided a complete copy of D7 with letter of 27 December 2021. The Board is thus satisfied that the single pages of the earlier submissions indeed form part of a complete document.

Already the list of Eagle Burgmann branches "in your vicinity" on page 2 indicates that the document is to be used by customers as a catalogue and not intended for internal use only. D7 moreover appears to specifically address "maintenance engineers, shop foremen and fitters and ... anyone seeking to profitably expand their seal-related expertise in the interest of their company" (page 38) for assisting them in making use of or reselling Burgmann products. The detailed technical information given in D7 is indeed

typical for such catalogues that present specific mechanical parts to such a readership to assist them in their design tasks. This is all the more so as in the present field of high-pressure pumps such mechanical construction parts are commonly highly regulated by industrial standards, such as ISO or API (American Petroleum Institute).

The Board concludes thus that D7 was intended for public distribution and use as a sales catalogue and design manual. In the light of the broad circle of possible customers and readers as well as the commercial aspect, the Board is not convinced by the Respondent's allegations that D7 was possibly distributed confidentially and under NDA only.

As apparent from the version number 15.4, preceded by 15.3 (D7A) and followed by 15.5 (D7C), the design manual has been regularly up-dated. The design manual 15.3 (D7A, page 2) bears the date 30 November 2004, 15.4 (D7, last page) 08.06 and a copyright note of 2006, 15.5 (D7C, last page) 09.09. In the absence of any evidence to the contrary, it can be assumed with a high level of confidence that these dates are production or printing dates, after which commercial brochures and catalogues are usually distributed as quickly as possible in order to serve their purpose as marketing instruments (see corresponding copyright by "Burgmann Marketing Communications Germany" on last page of D7), CLBA I.C.3.2.1.c).

The Board is therefore satisfied that D7 was made available to the public at the end of 2006 before the priority date of the patent on 22 January 2007. This conclusion is based on the reasons established above and does not need to be corroborated by further

evidence, as argued by the Respondent. This is so because the balance of probability is highly in favour of public availability of D7, so that the burden of proof to the contrary now lies with the Respondent. It is then not enough to make allegations or speculate on what might not have happened as expected or what might have gone wrong without providing any evidence.

3.3 Consequently, D6 and D7 are part of the prior art according to Article 54(2) EPC.

4. **Main request - Inventive step**

4.1 D6 discloses as closest prior art a multistage high-pressure pump, which has been specifically developed and designed for pressurizing sea water at a pressure level never reached before, see page 2, left column, last paragraph, page 3, "Design concept (B)" and Fig. 3, page 5 "Concept" and Fig. 8.Conventional components of this pump are a rotational shaft, to which impellers are secured, and a pump casing housing the impellers. Because of previous experience with sand contained in water causing problems, double mechanical seals are chosen to withstand an external pressure of 32 bar during operation, see page 4, "Mechanical Seals" and Table 3. The pair of seals of a double mechanical seal is housed in a seal chamber. In particular, double mechanical seals as shown in Fig. 11 with an externally circulating barrier fluid system have been selected (page 6, "Mechanical Seals").

As mentioned above, a barrier fluid is understood by the skilled person to be a fluid that is kept at a higher pressure than that of the pump medium in order to contain the pump medium in the pump chamber. As "externally circulating barrier fluid system" a

separate mechanical seal support system according to API plan 53 is installed at the side of D6's pump, see page 7, "General Arrangements". Although it is difficult to identify details of the seal support system in Fig. 13, the skilled person knows from the reference to this API standard (see for example the API plans 53A, B and C shown on page 97 of D7) that the support system includes a reservoir or accumulator for storing barrier fluid. The reservoir is in fluid communication with the seal chamber via a supply line. A circulation pump supplies and discharges the barrier fluid to and from the seal chamber via the supply line and an outlet line, respectively, both being also partly visible in Fig. 11 of D6. It is implicit that the elevated pressure of the barrier fluid in the seal chamber is maintained by some pressure retaining mechanism.

4.2 The subject-matter of claim 1 thus differs from the multistage high-pressure pump of D6 in that

- the buffer fluid is oil

and that

- the pressure retaining mechanism includes
  - a check valve provided on the oil supply line at a position between the oil pump, which is configured to pressurize the oil from the oil reservoir, and the seal chamber;
  - a further accumulator (in addition to the oil reservoir) located between the check valve and the seal chamber; and
  - a shut-off valve provided on the oil outlet line.

The multistage high-pressure pump of D6 with its double mechanical seal and barrier fluid system already solves the problem of not permitting leakage of high-pressure pump medium to the exterior, which is mentioned in

paragraph [0006] of the patent. With regard to the differing features, the Board therefore considers the problem to be solved as realising a suitable seal support system for the double mechanical tandem seal shown in Fig. 11 of D6, as also suggested by the Appellant.

4.3 The Appellant argues that the SPA seal supply system described on pages 113 and 114 of D7 represents a suitable and obvious option for the multistage high-pressure pump of D6.

Although D7 calls these seals supply systems on page 97, right column "*buffer systems*" for circulating "*buffer fluid*", the buffer fluid is in fact a barrier fluid with a pressure of "*10% or at least 1,5 to 2 bar above the maximum pressure to be sealed*". According to the table on page 113, most of the SPA systems are capable of delivering a barrier fluid pressure above the 32 bar required by D6.

Furthermore, for the buffer fluid unit SPA hydraulic oil represents a common buffer or barrier fluid, page 98, left column and page 113, "Features". Being an open circuit, the buffer/barrier fluid is not only circulated, but also re-pressurized by a pump after each circulation, page 96, right column, page 113, "Features" and scheme.

According to the SPA scheme shown in the top right hand corner of page 113, it includes a "DHE" unit placed between the pump and the mechanical seal. The DHE unit is detailed on page 114, left hand column, where it is referred to as a "pressure accumulator unit". As shown in the accompanying scheme in bold and described in the text, DHE is a pressure retaining mechanism that can

also be retrofitted to a SPA type buffer fluid system. As is apparent from the scheme is composed of a check-valve, a pressure gauge (PI, "pressure indicator", see also "Legend" on page 97) with shut-off valve and an accumulator, placed in this order along the oil supply line between the oil reservoir with the pump and the mechanical seal. In the outlet line between seal and reservoir the SPA scheme includes a piloted check valve which (see dotted line) can be taken to respond to the supply line. This is apparent from the standard symbol for a check valve, a "Z", with a dot in the bottom left angle indicating that when active it allows flow towards the mechanical seal.

4.4 First of all, the Board does not agree with the Appellant in that D7's SPA range of support systems represents an obvious choice for the skilled person as seal support system for the multistage high-pressure pump of D6.

Since D6 proposes a seal support system according to API plan 53, the skilled person would obviously look into systems and components, which comply with this standard. SPA does not comply with the API plan 53, as it is meant to conform to API Plan 54, which requires circulation of a clean fluid from an external system, see D7, page 97, table and "Plan 54". This involves a complex "open circuit" arrangement for relieving pressure of the barrier fluid, filtering and building up pressure again in each circulation, see page 96, "Open Circuit", page 113 "Features" and scheme. There is no obvious need for such a complex system in D6.

Whilst it is true that SPA offers additional safety with its pressure accumulator unit DHE in case the circulation pump fails (page 114), this is only

necessary for securing an open circuit system, in which the pump is also responsible for building up pressure of the barrier fluid. The tandem seal employed in D6 already provides safety under such circumstances. If (internal) pressure of the barrier fluid in the seal chamber drops unexpectedly, the then higher (external) pressure of the pump medium compresses the seal faces of the inboard seal, which withstand and seal under compressive stress (see also "Mechanical Seals" on page 6 of D6). If nevertheless for some reason the inboard seal should break, the high pressure of the pump medium exercises compressive stress on the outboard seal, which is arranged in the same orientation as the inboard seal and provides full redundancy and back-up safety.

Therefore, the skilled person would rather choose one of the options indicated in D7 for API Plan 53 in the table on page 97, namely TS1000 - TS6000 (API plan 53A), DRU (API plan 53C) and SPO (probabaly SPN, API plan 53B), which are described on the following pages 100 - 105 and 108, respectively. Unlike SPA, these belong to the category of "c*losed circuit*" systems, in which all the components including the reservoir are kept under the same pressure, page 96, right column. However, none of these circuit schemes shown on pages 100 - 105 and 108 comprises the differing structural features of claim 1. Moreover, water is commonly used as buffer or barrier fluid in closed circuits, see left column of page 98.

4.5 Furthermore, even if the skilled person were to contemplate incorporating an SPA type buffer fluid system with DHE unit, they would not arrive at the claimed invention. As noted the SPA scheme includes a piloted check valve in its outlet line. The Board is

however unconvinced that such a piloted check valve is a shut-off valve as required by claim 1.

According to the Appellant, the check-valve is not active and thus open during normal operation to allow the barrier fluid circulation from the mechanical seal towards the reservoir (see scheme on page 114 of D7). Rather, it is piloted in response to a pressure drop in the supply line to only then become operational and check flow from the reservoir towards the seal. It is thus also part of a pressure retaining mechanism and activated in case of pump failure to maintain pressure in the seal chamber. In the Appellant's view it therefore acts as a shut-off valve in the oil outlet line and is to be considered as such.

These explanations as to the functioning of the check valve appear quite plausible to the Board. However, even if this functioning of the check valve in the SPA system is similar to that of a shut-off valve, it is still not the same as a shut-off valve in the usual sense of that term. In the Board's understanding the term denotes a valve that stops all flow, i.e. shuts it off. Shut-off valves are for example common in the petroleum industry, where they are used to stop the flow of hazardous fluid upon detection of some dangerous event. A check valve (when operational) blocks flow only in one direction but remains open in the non-check direction. Even when activated, the piloted check-valve in the the oil outlet line of SPA thus still allows "reverse" flow of barrier fluid from the PCV valve towards the mechanical seal. Consequently, it is not a shut-off valve.

Therefore, a hypothetical combination of D6's pump with the SPA system of D7 would not result in the claimed

subject-matter.

4.6 In its written submission, the Appellant also briefly addressed a combination of D7 with D1 or D8. The Board has provided the following comments on these combinations under point 3.10 of its communication:

"*D1 discloses a dual seal, which seems to be operating with rather low pressure barrier or buffer fluid, see table of Fig. 3. It appears to be a less promising starting point, since it does not mention pressurization of buffer/barrier fluid above pump pressure. To the contrary, leakage of pump media into barrier/buffer fluid seems to be acceptable via chamber 35 at a pressure P3 higher than pressure P2 prevailing in seal chamber 17. Leaked pump media is then discharged into waste disposal recovery system 28 (see column 5, line 66 - column 6, line 11, Fig. 2). Also shown in Fig. 2 is part of a conventional seal support/supply system, see column 3, lines 29 - 63. Neither did the Appellant-Opponent detail, nor is it presently obvious to the Board why and how exactly a person skilled in the art would combine this seal support system of D1 with the SPA system of D7.*"

"*Furthermore, the gist of D8 seems to be the provision of a specific seal arrangement, which can prevent leakage even in the case of an abnormal pressure drop of the barrier fluid, see paragraphs [0003], [0004], [0019]. A barrier fluid accumulator as in D7 for upholding barrier fluid pressure in this case appears thus to be superfluous for D8's seal.*"

In other words, similar to D6's tandem seal, D8 already provides safety features for a pressure drop in the seal chamber: A pressure-activated flanged sleeve 11

pushes the seal ring 5 against the seal member 3 and thereby closes the seal gap, paragraph [0019], Fig.

Since the Appellant did not comment on or challenge the provisional opinion given with regard to documents D1 and D8, the Board has no reason to deviate from it.

5. For the above reasons a person skilled in the art would not obtain the subject-matter of claim 1 in an obvious manner from the cited prior art. Therefore it involves an inventive step in the sense of Article 56 EPC.

6. **Conclusion**

The Board therefore confirms the sole finding of the decision that the Appellant Opponent has challenged. Their appeal thus fails.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Magouliotis A. de Vries

Decision electronically authenticated