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Datasheet for the decision of 28 February 2023

Case Number: T 1618/19 - 3.4.03

Application Number: 12789274.3

Publication Number: 2751627

IPC: G06Q10/06, G05B19/418

Language of the proceedings: EN

Title of invention:
RUNDOWN BLENDING OPTIMIZATION APPARATUS AND METHOD

Applicant:
AspenTech Corporation

Headword:

Relevant legal provisions:
EPC Art. 52(1), 56, 83, 84, 123(2)

Keyword:
Inventive step - main request (no) - auxiliary request (yes) - mixture of technical and non-technical features
Amendments - added subject-matter (no)
Claims - clarity (yes)
Sufficiency of disclosure - (yes)

Decisions cited:
G 0001/19

Catchword:

Europäisches Patentamt
European Patent Office
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Beschwerdekammern

Boards of Appeal

Chambres de recours

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Case Number: T 1618/19 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 28 February 2023

Appellant: (Applicant)	AspenTech Corporation 20 Crosby Drive Bedford, MA 01730 (US)
Representative:	Driver, Virginia Rozanne Page White & Farrer Limited Bedford House 21A John Street London WC1N 2BF (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 14 December 2018 refusing European patent application No. 12789274.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	T. Häusser
Members:	A. Böhm-Pélissier
	G. Decker

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division to refuse patent application No. 12 789 274. The refusal was based on unallowable amendments (Article 123(2) EPC), lack of clarity (Article 84 EPC), lack of novelty (Articles 52(1), 54(1) and (2) EPC) and lack of inventive step (Articles 52(1) and 56 EPC).

II. Reference is made to the following **documents**:

D5 = DE 102 50 325 A1

D7 = ANONYMOUS: "Blending and Movement Automation, Open Blend Property Control, Specification and Technical Data", HONEYWELL, no. OB-SPT-340, 1 July 2010, pages 1-21, XP003033270 (filed by third parties)

D9 = Håvard Devold, "Oil and gas production handbook - An introduction to oil and gas production, transport, refining and petrochemical industry", Oslo 2013 (cited in the statement setting out the grounds of appeal)

III. The appellant requested at the end of the oral proceedings before the board that the decision under appeal be set aside and that a patent be granted on the basis of the claims according to the main request filed with the statement of grounds of appeal, or, alternatively, in the following version:

Claims: No. 1 to 11 according to the first auxiliary request filed with the statement of grounds of appeal.

Description: Pages 1 and 29 received during oral proceedings of 28 February 2023; pages 2 and 2a according to the first auxiliary request filed with the statement of grounds of appeal; pages 3 to 28 as published.

Drawings: Sheets 1/10 to 10/10 as published.

IV. **Claim 1** according to the **main request**:

(labelling [(A), (B),...] and highlighting/ strikethrough of amendments with respect to claim 1 of the main request discussed before the examining division were inserted by the board)

(A) A blending control system in a refinery comprising
(B) a splitter and a blender for implementing blending operations in rundown components supplied from the splitter without intermediate storage tanks,
(C) the blending control system comprising a computer modeling apparatus deploying a nonlinear optimization problem solver component acting on nonlinear parameters and discrete variables, the computer modeling apparatus comprising:
(D) an input module enabling user specification of inventory information including at least one rundown component, and user specification of refinery product commitments; and
(E) a processor routine executable by a computer and coupled to the input module and responsive to the user specification by sequencing refinery operation events

into a schedule that matches the refinery product commitments with inventory and unit rundown blending operations,
(F) wherein the refinery operation events include blend events; and
(G) the processor routine determining for the schedule the sequence and timing of refinery operation events, including the number and duration of event periods,
(H) ~~simultaneously with event volumes~~ optimizing event volumes simultaneously with recipes for product blends for the rundown blending operations of at least one rundown component supplied to the blender from the splitter; and
(I) determining the split ratio of the splitter, for splitting rundown component blending operations between refinery products and changing qualities of component streams,
(K) the blending control system using the schedule to provide a new value range to parameters and variables of the blending control system to control the blending operations
(L) wherein the sequence of timing of blend events is determined as well as the blend recipes while ensuring that the entire volume of the at least one rundown component is used as it becomes available.

V. **Claim 6** according to the **main request**:

(A') A computer-implemented method of controlling a splitter in a blending control system
(B') to implement rundown blending operations for rundown components supplied from the splitter to a blender without intermediate storage tanks,
(C') using a nonlinear optimization problem solver acting on nonlinear parameters and discrete variables, the method comprising:

(D') collecting inventory information including at least one rundown component; collecting refinery product commitments of a refinery; and
(E')-(F') sequencing refinery operations events including determining the sequence and timing of blend events and blend recipes for rundown blending operations for a schedule that matches refinery product commitments with inventory and unit rundown blending operations, such that the schedule of refinery operations is optimized; the sequencing including ~~determining~~:
(G') determining sequence and timing of refinery operation events, including the number and duration of event periods;
(H') optimizing, simultaneously with event volumes, recipes for product blends for the rundown ~~random~~ blending operations of at least one rundown ~~random~~ component supplied to the blender from ~~form~~ the splitter; ~~and~~
(I') determining a split ratio of the splitter, for splitting rundown ~~random~~ component blending operations between refinery products and changing qualities of component streams,
(K')-(L') wherein the sequence and timing of blend events is determined as well as the blend recipes; and
using the schedule to control rundown blending operations using the splitter, while ensuring that the entire volume of the at least one rundown component is used as it becomes available.

VI. **First auxiliary request** (labelled "AUXILIARY REQUEST" in the version filed together with the statement of grounds of appeal)

To the main request feature (J)/(J') was added between features (I) and (K) (claim 1) and features (I') and (K')-(L') (claim 6), respectively:

(J)/(J') wherein the processor routine implements a mathematical model which implements a series of optimizations and which applies penalties to encourage the sequence of blends to remain the same from one optimization and the next, and to minimize the number of changes in the split ratio for the or each splitter

VII. The appellant **argued** essentially as follows in relation to inventive step:

(a) Main request: D5 did not disclose - at least partially - features (B), (D), (E), (H), (I) and (L); none of the cited documents, in particular D7, taught these features.
(b) First auxiliary request: nothing in the state of the art disclosed or suggested feature (J).

Reasons for the Decision

1. The invention as claimed

1.1 The invention relates to product blending and component inventory management in a refinery. The objective of the product blending operations is to meet all the shipment commitments on schedule, while operating within the tank inventory constraints both for the blending components as well as the blended products. This operation should be executed in an optimal fashion in terms of overall cost and profitability. A multi-period blending optimisation system produces the

optimum schedule for blending, along with optimum recipes and blended volume for each blend, while addressing the underlying inventory optimisation problem.

1.2 It is an alleged object of the invention to additionally minimise give-away losses (losses that occur when a premium quality product must be sold for the regular product price), to utilize better the most valuable components in higher quality products or as direct sales, thus increasing the net profitability of the refinery. A further objective is to realise a multi-period blending optimisation system that can optimise blending operations for components without storage tanks (see pages 1 and 2 of the application).

1.3 This is achieved by a nonlinear mathematical model which simulates an ongoing refinery process taking into account initial values and cost parameters (main request) and by minimising the number of changes of the split ratio for a splitter and of the sequence of blends (first auxiliary request).

2. **Main request - Articles 83, 84 and 123(2) EPC**

2.1 The objections of the examining division under Articles 84 and 123(2) EPC have been overcome by the amendments in feature (H). It is now clearly claimed that the event volumes are optimized simultaneously with recipes for product blends. The amendments are based on page 5, lines 14 and 15 and page 8, lines 2 to 4 of the description as published.

2.2 Feature (L) is based on the following sentence in the description: "*The challenge of rundown blending is to determine the sequence and timing of the blend events*

as well as their optimal recipes while ensuring that the entire volume of both rundowns is used as it becomes available" (sentence bridging pages 18 and 19, see also page 24, lines 15 to 18, underlining added by the board). In section 15.2 of the impugned decision, the examining division objected that a challenge was not a solution or an invention and, when claimed as such, extended the scope of the application (Article 123(2) EPC) and might lead to an objection of lack of disclosure (Article 83 EPC).

2.3 The board agrees with the examining division that the description defines a "challenge". However, this "challenge" is overcome by the features listed in the independent claims and by explanations in the description, e.g. page 22, line 1 to page 23, line 4. Furthermore, Figure 6 relates to a detailed Gantt chart in which the optimal mixing schedule is shown as determined by the proposed model. The diagram shows the sequence of mixing operations and is based on the total volumes of the settled components. Therefore, it is legitimate to define this result as a "challenge" in the description. Since the "challenge" is ultimately overcome by the features of the independent claims, the relevant passage can serve as the basis for amending the claims.

2.4 In summary, amending a feature in the independent claims based on a passage in the description where the feature is called a "challenge" is legitimate if the challenge is overcome by the remaining features of the claim and if the application discloses these features in a manner sufficiently clear and complete that they can be carried out by a person skilled in the art. Therefore, feature (L) of claim 1 and the corresponding feature of claim 6 are directly and unambiguously

derivable from the application as filed and are disclosed in the application in an enabling manner.

2.5 In view of the above, the board is satisfied that the requirements of Articles 83, 84 and 123(2) EPC are met.

3. **Main request - inventive step**

3.1 **Technicality**

3.1.1 The claimed subject-matter relates to a concrete apparatus, namely a blending control system in a refinery, and a corresponding method and is therefore overall undoubtedly technical.

3.1.2 Moreover, the claimed blending control apparatus/method comprises a computer modeling apparatus/method. The modeling is performed for an active refinery process in an actual refinery. The feeding of the model with the input parameters (flow and product parameters of the "rundown components supplied from the splitter" and refinery product commitments) as well as the direct conversion of the simulation results ("blend recipes", "blend events", "blend timing", "split ratio") into output signals for the control of the blender and splitter in the refinery process can be considered technical inputs / outputs according to G 1/19, OJ EPO 2021, A77, reasons 85, and are therefore technical or have a technical effect.

3.1.3 The feeding of process parameters of a running process, i.e. the refinery process, into the simulation and the conversion of calculated process parameters into control signals are thus indications of a "direct link with physical reality" (G 1/19, reasons 88) and of a "further technical effect" that goes beyond the mere

technical implementation of the algorithm in a computer (G 1/19, reasons 91). Consequently, it is irrelevant whether the final step of implementing the optimisation results by means of control signals, i.e. to the splitter and blender, is explicitly claimed (as would be recommended in principle according to G 1/19), if the skilled person understands from the wording of the claim, in particular from features (A), (B), (H), (I), (K) and (L) in claim 1 and the corresponding features in claim 6, that the simulation results are directly converted into control signals of the splitter and blender. This is the case here.

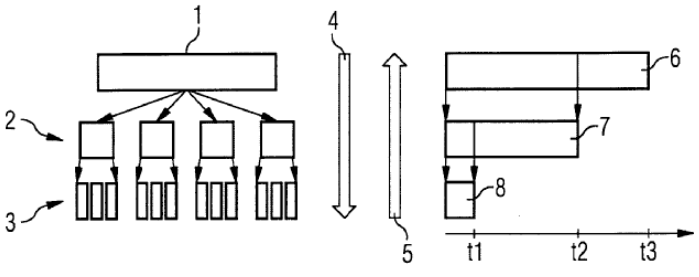
3.1.4 Consequently, the entire subject-matter of claims 1 and 6 is considered technical.

3.2 **Closest state of the art**

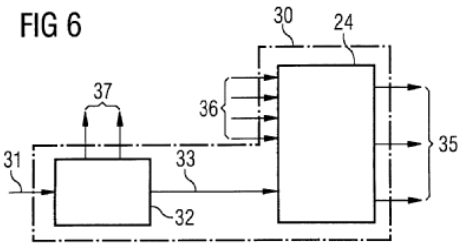
D5 is considered the closest state of the art. D5 describes nonlinear modelling of a catalytic reformer process in a refinery and thus most of the features of claims 1 and 6. D7 also discloses most of the features of claims 1 and 6, but does not provide details about the model and does not, in particular, disclose feature (H). D7 is therefore a less suitable spring-board for the problem and solution approach.

3.3 **D5**

FIG 1



D5



D5

3.3.1 D5 discloses in paragraphs [0005], [0010], and [0037]-[0065] modelling and optimising the whole refinery process and in particular the blending process. The modelling in D5 is divided into a planning level (6 in Fig. 1) and a short/long-term modelling level (7 in Fig. 1). The parameters of level 6, such as amounts of the end product to be produced ([0005]), are fed into the model 7. The refinery process is subdivided into sub-processes 2 and sub-sub-processes 3, which may be considered the "events" referred to in claim 1.

3.3.2 Therefore, it was undisputed that D5 discloses features (A), (C), (F), (G) and (K).

3.4 Difference between the disclosure of D5 and claim 1

3.4.1 The appellant argued that D5 did not disclose rundown components, a splitter, and "event volumes", in particular the simultaneous optimization of event volumes and recipes for product blends. D5 referred only to the modeling of flows. Since D5 did not disclose a splitter, split ratios were not determined and adjusted in D5, and consequently the absence of an intermediate storage tank between the splitter and the blender was also not disclosed. Consequently, D5 did not disclose - at least partially - features (B), (D), (E), (H), (I) and (L).

3.4.2 The main discussion during the hearing was whether D5 discloses feature (H), i.e. *optimizing event volumes simultaneously with recipes for product blends for the rundown blending operations of at least one rundown component supplied to the blender from the splitter*.

3.4.3 The board agrees that D5 fails to disclose:

(a) a splitter
(b) determining the split ratios
(c) the absence of intermediate tanks between splitter and blender
(d) rundown components as input components

3.4.4 The reformer 32 in Figure 6 may comprise a splitter or splitting process, but this is neither explicitly nor implicitly disclosed in D5. Furthermore, D5 only mentions supply to the refinery from tanks. Although the feature "rundown component" is a rather broad term, the skilled person understands the term "rundown component" as a component being continuously supplied from another process or a pipeline.

3.4.5 The board holds that D5 discloses "event volumes" ("*zu produzierende Produktmengen*" [0005], "*Optimierung der in der Scheduling-Ebene ermittelten Führungsgrößen*" [0036], "*Mengenbeschränkungen für Zwischenprodukte*" [0051], "*Volumenbilianzen*" [0072]). Furthermore, D5 discloses modeling and optimising the "blending recipes" ("*Verteilung der Blending-Komponenten*" [0035], "*Mischungsregeln*" [0072]).

3.4.6 Furthermore, D5 discloses modelling the entire refinery process and that measured input values from this process are continuously fed into the model ("*unterschiedliche Messgrößen aus dem laufenden*

Anlagenbetrieb [werden] benötigt und verwendet" [0014]).

3.4.7 D5 therefore discloses a part of feature (H) as follows: "*optimizing event volumes simultaneously with recipes for product blends for the ~~rundown~~ blending operations of at least one ~~rundown~~ component supplied to the blender ~~from the splitter~~*."

3.5 **Effect and problem**

3.5.1 The appellant defined the technical problem as "providing a blend control system that is more cost effective and provides a higher quality blend than the system in D5".

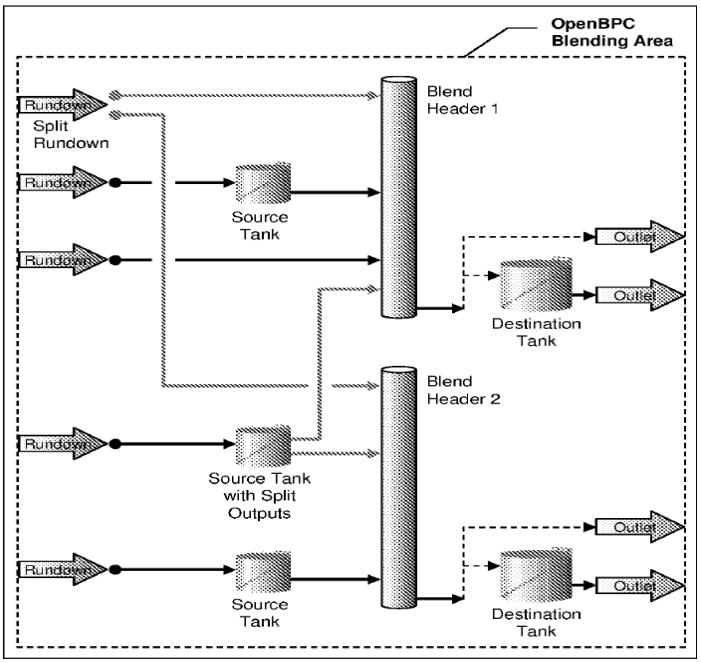
3.5.2 In this regard, the board disagrees because the differing features do not improve the model, schedule, or blending process in D5. These features are not explicitly mentioned in D5 simply because the focus in D5 is not on the refinery process as such and the refinery infrastructure, but rather on the modeling, planning, and scheduling.

3.5.3 The board therefore defines the problem to be solved as implementing the model described in D5 in a realistic refinery infrastructure.

3.6 **Obviousness**

3.6.1 D7 discloses a planning tool for a refinery comprising optimisation of the blending and the blending schedule. Figure 4-1 shows the process on which the simulation is based:

Figure 4-1 – Interacting Blenders Example



D7

D7 thus discloses that both the processing of rundown components, as well as a splitter, and the optional use of buffer tanks or even the omission of such tanks between splitter and blender, are known options to the skilled person. Furthermore, D7 discloses determining split ratios of rundown components (page 6, last but one sentence).

3.6.2 The appellant argued that D7 optimized only the blending but did not relate to determining the sequence of refinery events which match refinery product commitments with inventory and unit rundown blending operations. D7 taught away from an integrated scheduling and blending operation. It was not disputed by the appellant that splitters and the use of rundown components are commonplace.

3.6.3 The board is of the opinion that an integrated scheduling and blending operation is disclosed in D5. D7 illustrates only by way of example the general appearance of a somewhat more detailed refinery

infrastructure that the skilled person would consider in place of the schematic in Figure 6 of D5 when working out the disclosure of D5.

If the skilled person applies the modeling tool of D5 to a realistic refinery process - exemplarily and schematically shown in Figure 6 of D5 - they would design the incoming streams 36 / 31 (Figure 6 of D5) as rundown components, i.e. coming from another process or from a pipeline, and also design the reformer 32 with a splitter for splitting the streams of the starting products according to the blending recipe for the blending process. As shown in Figure 4-1 of D7, the skilled person would also consider the option of no intermediate storage tank between splitter and blender. This would lead the skilled person in a straightforward manner to features (a) through (d) listed in point 3.4.3 above.

3.6.4 Consequently, the board is of the opinion that the subject-matter of claim 1 is not inventive over D5 in combination with document D7 and the common general knowledge of the skilled person (Articles 52(1) and 56 EPC).

4. **First auxiliary request - inventive step**

4.1 **Amendments**

New feature (J)/(J') is based on page 17, lines 5 to 10, and page 18, line 1 to 2 and complies with the requirements of Article 123(2) EPC. Although taken from the description, feature (J)/(J') is formulated as a general statement independent of other features and is thus not considered an inadmissible intermediate generalisation.

4.2 **D5**

D5 discloses mathematical optimisation of the parameters ([0037]) and using weighting factors ([0048]). The weighting factors may be considered equivalent to the penalties in the present application (see equation (19) in the description of the application).

4.3 **Difference between the amendments of claims 1 and 6 of the first auxiliary request and document D5**

4.3.1 D5 therefore discloses that the processor routine implements a mathematical model which implements a series of optimizations and which applies penalties.

4.3.2 D5 fails to disclose:

(e) to encourage the sequence of blends to remain the same from one optimization and the next
(f) to minimize the number of changes in the split ratio for the or each splitter

4.4 **Effect and problem**

The effect of differing features (e) and (f) is independent from the effect of differing features (a) to (d). Features (e) and (f) have the effect of increasing the robustness of the blend schedule and blending system (page 17, lines 8 to 10). This applies to both the optimisation problem and the refinery infrastructure. Every change leads to additional risks and efforts, both in terms of timing, production downtime and additional personnel and material expenses. The additional partial problem to be solved

may therefore be formulated as "increasing the robustness of the system and running the optimisation of the scheduling in a conservative manner".

4.5 **Non-obviousness**

ad (e)

4.5.1 D5 does not disclose a "conservative system", but a system with high flexibility ([0018]), e.g. to deal with particularly favorable or cheap crude oil being available on the spot market at short notice. In this case, production volumes can be increased at short notice in order to benefit from the currently favorable crude oil ([0036]). This already leads away from the problem to be solved.

4.5.2 If the skilled person is entrusted with the problem to be solved, the straightforward solution would be to use the weighting factors in D5 to make the system more "inert". However, the weighting factors in D5 ([0048], [0089]) are used differently than in the present application (see equations (19) and (24) in the description of the application). The weighting factors are used as part of the optimization procedure and are used to converge the optimization towards a termination criterion ([0055], Figure 5). These weighting factors cannot make the system as a whole more "inert" with respect to certain specific parameters.

4.5.3 In order to run the optimisation of the scheduling in a conservative manner, the skilled person would first have to select, out of a variety of parameters, the specific parameters to be discouraged by the system for change. One solution would be to make the blends themselves more "inert", i.e. to reduce the changes from one blend to the next blend, e.g. by introducing a

"damping" mechanism which reduces the changes determined by the optimization scheme. This is however not what is claimed. Rather, independent claims 1 and 6 of the first auxiliary request require that the "sequence of blends" and thus the order and timing of the blends should remain unchanged from one optimization to the next. There is no suggestion for this feature in the available state of the art, neither in D5 nor in D7 nor in any other cited document.

ad (f)

4.5.4 Furthermore, since D5 itself does not reveal any splitter, the skilled person does not receive any suggestion to minimize the changes in the split ratio. D7 and D9 and the other cited documents are also completely silent about this feature.

4.5.5 Hence, the board is of the opinion that the subject-matter of claims 1 and 6 of the first auxiliary request is not obvious to the skilled person. Claims 2 to 5 and 11 and claims 7 to 10 are dependent on claims 1 and 6, respectively.

Accordingly, the subject-matter of claims 1 to 11 of the first auxiliary request involves an inventive step (Articles 52(1) and 56 EPC).

5. **Summary**

The subject-matter of claim 1 of the main request does not involve an inventive step.

The first auxiliary request fulfills the requirements of the EPC. The board notes that the description has been adapted to the claims of the first auxiliary

request. Hence a patent is to be granted on the basis of this request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division with the order to grant a patent in the following version:

Claims: No. 1 to 11 according to the first auxiliary request filed with the statement of grounds of appeal.

Description: Pages 1 and 29 received during oral proceedings of 28 February 2023;
pages 2 and 2a according to the first auxiliary request filed with the statement of grounds of appeal;
pages 3 to 28 as published.

Drawings: Sheets 1/10 to 10/10 as published.

The Registrar: The Chairman:

S. Sánchez Chiquero T. Häusser

Decision electronically authenticated