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**Datasheet for the decision  
of 22 February 2017**

**Case Number:** T 1441/15 - 3.2.05

**Application Number:** 09735483.1

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**IPC:** F16K47/08

**Language of the proceedings:** EN

**Title of invention:**

Control valve

**Applicant:**

Cameron International Corporation

**Relevant legal provisions:**

EPC Art. 54, 56, 84, 123(2), 111(1)

**Keyword:**

Novelty - yes

Inventive step - yes

Remittal to the examining division



**Beschwerdekammern**  
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Case Number: T 1441/15 - 3.2.05

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.05**  
**of 22 February 2017**

**Appellant:** Cameron International Corporation  
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**Decision under appeal:** **Decision of the examining division of the  
European Patent Office posted on 4 March 2015  
refusing European patent application No.  
09735483.1 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** S. Bridge  
**Members:** H. Schram  
D. Rogers

## **Summary of Facts and Submissions**

- I. The appellant (applicant) filed a notice of appeal against the decision of the examining division, posted on 4 March 2015, by which European patent application No. 09 735 483.1 was refused.

The examining division held that the subject-matter of claim 1 of the main request filed with letter of 7 January 2015, wherein the expression "in-line" had been deleted at the request of the applicant during the oral proceedings held on 10 February 2015, was not new, Article 54 EPC (see point 10.2 and 10.3 of the Reasons), that the subject-matter of claim 1 of auxiliary requests I, II and III filed with letter of 7 January 2015 [the request concerning "in-line" mentioned above applied also to claim 1 of auxiliary request II] was not clear, Article 84 EPC (see points 11 to 13 of the Reasons), that auxiliary request IV filed with letter of 7 January 2015 was not allowable, since the additional feature of said request merely represented a desired result to be achieved without giving any guidance which specific constructional details were necessary to achieve this result (see point 14 of the Reasons), and that the subject-matter of claim 1 of auxiliary request V filed during said oral proceedings did not involve an inventive step, see point 15 of the Reasons.

- II. Oral proceedings were held before the board of appeal on 22 February 2017.
- III. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the main request filed during the oral proceedings on 22 February 2017.

IV. Claim 1 of the main request (sole request) reads as follows:

"1. A valve (12, 120), comprising:  
an in-line flow passage (44);  
a shut-off mechanism; and  
a multi-stage throttling section (26, 132) disposed in the in-line flow passage (44), wherein the multi-stage throttling section (26) comprises a first throttling component and a second throttling component in series with the first throttling component;  
the first throttling component comprises one or more throttling discs (96, 106);  
the second throttling component comprises one or more throttling discs (96, 108);  
characterized in that:  
the first throttling component is formed from a first material and the second throttling component is formed from a second material that is different from the first material, wherein the second material is more ductile than the first material;  
the second throttling component being disposed downstream from the first throttling component."

V. The documents referred to in the appeal proceedings include the following:

D1 US 4,295,493;

D8 US 4,226,368;

D9 *Physical Ductility of the Elements*, Christensen, R. M., available at <http://www.failurecriteria.com/physicalductilit.html>.

VI. In support of his requests, the appellant submitted essentially the following:

Claim 1 of the main request was novel and inventive having regard to the cited prior art, for the following reasons.

As discussed in paragraph [0040] of the specification, a particular problem arose with throttling valves of the kind recited in said claim 1. The fluid being throttled abraded the throttling discs and led to wear and eventual failure of the discs. To increase the resistance of the throttling discs to wear, it was known to form the throttling discs from a hard material. However, as discussed in the specification, hard materials having a high resistance to wear were susceptible to cracking. Over time, the throttling discs formed from the hard material became brittle and cracked. This in turn caused part or all of the throttling discs to become dislodged and entrained in the fluid stream. The fragments of the throttling disc moved downstream with the fluid and could impact downstream components, such as downstream throttling discs, causing damage and/or could become lodged in downstream equipment. In addition, the absence of a portion of a throttling disc, or a crack therein, could reduce the throttling effect of the disc, in turn reducing the overall performance of the valve assembly.

It had been found that the lifetime and efficiency of a throttling valve as recited in the pre-characterizing portion of claim 1 was significantly increased by providing a plurality of throttling discs and forming a first throttling disc from a first material and a second throttling disc from a second material,

different to the first, and in which the second material was more ductile than the first material.

In this arrangement, the throttling disc having the lower ductility was harder and more resistant to wear. The throttling disc formed from the second material was more ductile and was resistant to cracking and fracturing. The combination of two throttling discs, one relatively harder and one relatively more ductile, reduced the occurrence of a brittle disc cracking and fracturing, while maintaining the overall resistance to wear of the throttling assembly.

Document D1, which represented the closest prior art, concerned a drag ball valve including variable pressure reducing means. The variable pressure reducing means comprised a plurality of discs, including a plurality of fixed discs 34 and a plurality of rotatable discs 42. This document taught (see column 2, line 65, to column 3, line 1, and column 3, lines 11 to 13) that discs 34 might be stamped from a metallic or other material that was non-corrosive to the usual fluids which passed through the valve and that discs 42 might be stamped from a non-corrosive metallic material. There was no clear and unambiguous teaching in document D1 that the discs 34, 42 were formed from different materials, as required in the characterising portion of claim 1 of the main request. Moreover, document D1 was entirely silent about the ductility of the materials from which the discs 34, 42 were formed. Accordingly, for these reasons, claim 1 of the main request was novel having regard to document D1. Even if the discs 34 were formed from a different material to the discs 42, it did not follow that the two materials had a different ductility. This followed from document D9, which taught (see Table 1) that different materials

could have the same ductility, for example gold and lead, or silver and vanadium.

Document D8 disclosed a multiple vortex dripper, which employed a sprinkler head, see Figures 1 and 14. The sprinkler head comprised a plurality of disc-shaped plates 96 that were separated by rubber gaskets 100 (see column 6, lines 50 to 55). This document taught (see column 3, lines 58 to 63) that the disc-shaped plates 96 were all formed from the same plastic or, although less preferred, metal. The rubber gaskets (100) were provided merely to provide a seal, in a conventional manner, to prevent fluid leaking from the intended flow path. There was nothing in document D8 which suggested that the rubber gaskets 100 were provided as a means of throttling the fluid flow and the person skilled in the art would not understand that the teaching of document D8 was that the rubber gaskets 100 acted as a throttling disc, as recited in claim 1 of the main request. Even if the rubber gaskets 100 were considered as throttling discs, said claim was new, since there was no clear and unambiguous disclosure in document D8 that the disc-shaped plates 96 and the rubber gaskets 100 were formed from materials having a different ductility. Claim 1 of the main request was therefore novel with respect to document D1.

The subject-matter of claim 1 of the main request also involved an inventive step. Document D1 addressed the problem of a lack of variability in the pressure drop effected by ball valves, see column 1, lines 45 to 48. It was noted that if the pressure reduction in drag ball valves was substantial enough, the velocity of the fluid could approach sonic levels which resulted in excessive vibration and valve noise, both of which led

to the deterioration of the valve, see column 1, lines 15 to 21. In addition, if the pressure of the fluid dropped below its vaporization pressure, partial vaporization of the fluid could occur resulting in a process called cavitation which greatly accelerated the deterioration of the valve, see column 1, lines 21 to 25. Document D1 was not concerned with the problem of failure, i.e. cracking or breaking up, of the discs. The skilled person would first have to recognize the problem of disc failure, and if so, she or he would probably envisage making the discs thicker or stronger, rather than changing the ductility of the discs. In any case, the skilled person had no incentive to providing first and second throttling discs having different ductilities.

The skilled person, starting from document D1 and seeking to provide a valve that mitigates the likelihood of failure, would not look for a solution in document D8, since that document disclosed a sprinkler head for use in drip irrigation systems for plants or trees, see Figure 1. Whilst document D1 was concerned with a valve having aggressive fluids passing therethrough, the fluid passing through the drip irrigation system valve was water. Since document D8 did not hint or suggest to provide first and second throttling discs having different ductilities, the subject-matter of claim 1 of the main request was not obvious to the person skilled in the art.



## **Reasons for the Decision**

1. The appeal is admissible.

### MAIN REQUEST

2. *Allowability of the amendments, Article 123(2) EPC*

- 2.1 Claim 1 of the main request differs from claim 1 as filed (apart from the insertion of the expression "characterized in that" and including reference signs) in that the following features have been added:

(i) wherein the multi-stage throttling section (26) comprises a first throttling component and a second throttling component in series with the first throttling component;

(ii) the first throttling component comprises one or more throttling discs (96, 106);

(iii) the second throttling component comprises one or more throttling discs (96, 108);

(iv) the first throttling component is formed from a first material and the second throttling component is formed from a second material that is different from the first material;

(v) wherein the second material is more ductile than the first material;

(vi) the second throttling component is disposed downstream from the first throttling component.

A basis for features (i), (v) and (vi) is claim 5, 8 and 6 as filed, respectively. A basis for features (ii) and (iii) is claim 2 as filed. A basis for feature (iv) is claim 7 as filed, in combination with paragraphs [0039] of the application as filed (hereafter: application).

Claims 2 to 11 of the main request correspond to claims 3, 4, 10, 11, 12, 13, 15, 16, 17 and 18 as filed, respectively. A basis for claim 13, which is directed to an oil or gas production system comprising a valve according to any preceding claim, is paragraph [0004], line 5, of the application.

2.2 The claims of the main request therefore meet the requirements of Article 123(2) EPC.

3. *Clarity of the claims, Article 84 EPC*

3.1 The examining division held that the expression "in-line flow passage" was not clear, see point 11 of the Reasons of the decision under appeal.

The term "in-line" (or "straight-line") occurs, apart from in the abstract and in claims 1, 15 and 19, in the following paragraphs of the application:

[0017] ... and a throttling section 26 in an axial slab (e.g., **in-line**) valve configuration;

[0019] ... The primary passage 44 defines an **in-line** (e.g., straight) bore that runs from the inlet 28 to the outlet 30;

[0036] In another embodiment, each of the ports 98 of each of the throttling discs 96 may be aligned in series to provide an in-line (e.g., **straight-line**) flow path through the throttling section 26;

For example, one or more of the flow paths 104 may include an **in-line** (e.g., straight-line) flow path, whereas other ports may include offsets between each of the complementary ports 98 of the throttling discs 96 such that the flow path 104 is irregular (e.g., not an **in-line** flow path);

[0056] ... In addition, the routing system 168 includes a third valve 178 that is disposed **in-line** with another of the fluid inputs 170. Further, the routing system 168 includes a fourth valve 180 **in-line** with the output 172; and

[0057] The output 172 of the routing system 168 is in fluid communication with the processing system 158 via a connection that includes an **in-line** valve 182.

In the opinion of the board, the person skilled in the art would understand the term "in-line flow passage", on the basis of paragraphs [0017] and [0019], as meaning that the flow passage from the inlet to the outlet of the valve is a straight line. This is also clear from Figure 8, which shows an **in-line** valve 182, cf paragraph [0057].

During the oral proceedings before the board, the appellant confirmed that the embodiment shown in Figure 6 of the application no longer falls under the ambit of claim 1 of the main request.

It may be noticed that in paragraph [0036] the term "in-line" is used in connection with the term "flow path", not in connection with the term "flow passage" and that in paragraphs [0056] and [0057] the term "in-line" is used in yet another meaning, namely to describe valves that are "in-line" with another valve.

- 3.2 The examining division held (see point 10.7.3 of the Reasons) that, if the last feature of claim 1 of the (then) main request, viz "wherein the second material is more ductile than the first material", were to be considered as (at least formally) distinguishing the claimed subject-matter from the prior art, this would not result in an inventive subject-matter, since the claim merely required the ductility of the first and second material "not being the same", and the chances for the materials used in documents D1 and D8 to meet this requirement were much more likely than not (in particular in document D8, where plate 96 was made of plastic or metal and gasket 100 was made of rubber, cf point 10.7.2 of the Reasons).

While it is true that claim 1 of the main request does not specify to which extent the ductility of the second material is different from the ductility of the first material, this is not to say that the difference in ductility can be arbitrarily small. The difference in ductility must be sufficient to measurably reduce the likelihood of failure of the components multi-stage throttling section, resulting in reduced wear and improved lifetime.

- 3.3 The examining division held (see point 12.2 of the Reasons) that specifying that "the second throttling component is disposed downstream from the first throttling component" did not represent a

constructional limitation, thus resulting in a lack of clarity, Article 84 EPC, since the flow direction in the valve may be reversed or the flow may be bidirectional, cf paragraph [0047] of the application.

It may be noticed that for valves with a unidirectional flow from the inlet to the outlet of the valve it is clear to the skilled person what the term "downstream" in claim 1 of the main request means, namely that the multi-stage throttling section is disposed in the flow passage such that the second throttling component is closest to the outlet of the valve.

However, if the valve is configured for bi-directional flow (cf. claim 8) and thus allows the flow to be reversed, the skilled person will readily understand that this implies that the multi-stage throttling section must include a second throttling component in series with the first throttling component both upstream and downstream, see paragraph [0047] of the application, last sentence. The additional feature of claim 1 of the main request is thus a constructional limitation of the claimed valve.

3.4 The person skilled in the art will understand the term "interchangeable" in claim 2 of the main request, viz "wherein the throttling discs (96, 106, 108) are interchangeable", in the sense that - for a given set of throttling discs of a multi-stage throttling section - said discs may be rearranged in any order to provide a desired pressure drop, cf paragraph [0037] of the application.

3.5 The claims of the main request thus satisfy the requirements of Article 84 EPC.

4. *Objection of lack of novelty, Article 54 EPC*

4.1 The technical effect of the characterizing part of claim 1 of the main request, viz "the first throttling component is formed from a first material and the second throttling component is formed from a second material that is different from the first material, wherein the second material is more ductile than the first material; the second throttling component being disposed downstream from the first throttling component", is described in paragraph [0040] of the application. In particular, the ductile nature of the second throttling component (retaining throttling disc 108) may provide support of the first throttling component (throttling disc 106) while providing greater resistance to cracking of the second throttling component itself.

4.2 The examining division held (see point 10.7.1 of the Reasons) that the ductility of materials could change if conditions were altered, that the ductility of many metals increased with temperature and that the expression "ductile" was a relative term such as hard or soft, which could not be used to distinguish the invention of the prior art.

The term "ductile" is a technical term. The relationship between Poisson's ratio  $\nu$ , which is the ratio of transverse contraction strain to longitudinal extension strain in the direction of stretching force, and the physical ductility  $D$  is addressed in document D9. The physical ductility  $D(\nu)$  is a function of  $\nu$  only and can be easily calculated from equations (3), (5) and (6) of document D9. This document includes (see page 2, Table 1) a list of Poisson's ratio and physical ductilities of various elements of the Periodic Table of Elements.

Since Poisson's ratio  $\nu$  can be measured for other materials as well, the physical ductility of these materials can be obtained as well. While Poisson's ratio and therefore the physical ductility may change with temperature, this does not make the feature "wherein the second material is more ductile than the first material" unclear, since the person skilled in the art will compare the respective ductilities of the materials at the same relevant temperature.

- 4.3 Document D1 discloses a valve having all the features of the preamble of claim 1 of the main request. One of the fixed disks 34 and an adjacent rotatable disk 42 shown in Figure 1 can be regarded as first and second throttling components forming a multi-stage throttling section.

This document further discloses (see column 2, line 65, to column 3, line 1, and column 3, lines 11 to 13) that "[Disk 34] ... may be stamped from a metallic or other material that is non-corrosive to the usual fluids which pass through ... the valve" and that "[Disk 42] ... may be stamped from a non-corrosive metallic material ...".

The person skilled in the art will learn from said passages that disks 34, 42 may be stamped from the same non-corrosive metallic material, or from different non-corrosive metallic materials, or that disk 42 may be stamped from a non-corrosive metallic material and disk 34 from a non-metallic material. The latter two possibilities correspond to the first half-sentence of the characterizing part of claim 1 of the main request.

Document D1 is silent about the ductility of the possible materials of the disks 34, 42.

Claim 1 of the main request is therefore new with respect to document D1.

- 4.4 Document D8 discloses a valve having all the features of the preamble of claim 1 of the main request. One of the disc-shaped plates 96 and an adjacent disc-shaped gasket 100 shown in Figure 14 can be regarded as first and second throttling components forming a multi-stage throttling section.

The appellant has submitted (see statement setting out the grounds of appeal, page 9, 6th paragraph, and point VI above) that the rubber gaskets 100 did not act as throttling discs.

This cannot be accepted. As shown in Figure 6, each gasket 100 is provided with six radially equally spaced holes 106 providing entrance to, and exit from, the six dropping paths formed by the covered interconnected depressions 98 contained within each plate 96 (see column 7, lines 1 to 5). This is very similar to the throttling discs 96, 108 described in paragraphs [0034] and [0037] and shown in Figure 4 of the application.

The passage in column 3, lines 58 to 63, reads as follows: *"Except as otherwise described, it is preferred that all the components employed herein be formed of plastics such as, for example, polyvinylchloride which are widely used in the sprinkler art. While not preferred, metal could, of course, be employed"*. In the preferred embodiment described in column 6, lines 50 to 55, the disc-shaped gaskets 100 are referred to as "disc-shaped rubber gaskets".



The person skilled in the art will learn from these passages that plate 96 may be formed from plastic or metal and that gasket 100 is formed from rubber. Document D8 is silent about the kind of plastics (apart from mentioning polyvinylchloride) or metals that can be used for plate 96 and silent about the kind of rubber that can be used for gasket 100. It may be noticed that Poisson's ratio for various kinds of rubber, such as e.g. natural rubber, polyurethane rubber and silicon rubber, may be different and that applies *mutatis mutandis* to the ductility thereof.

Document D8 does not disclose the ductility of the possible materials of plate 96 and gasket 100.

Claim 1 of the main request is therefore new with respect to document D8.

4.5 In that sense the main request is found to be allowable with respect to the main grounds for refusing the application (lack of novelty, and lack of clarity of the term "downstream").

5. *Inventive step with respect to documents D1 and D8, Article 56 EPC*

5.1 The invention relates to flow control systems. More particularly, it relates to a valve suitable for use with various fluid handling systems. The claimed valve is designed to limit (i.e. throttle) the pressure and flow rate of the fluid flowing through the valve, and may be employed in any variety of applications and industries, such as oil and gas systems. Throttling may be particularly well suited to direct fluid flow from oil and gas wells where the pressure of the fluids being expelled from the mineral reservoir may exceed

3,000 pounds per square inch, see paragraphs [0003] and [0004] of the application. Due to the high flow rates, high pressures, and the abrasive nature of certain fluids, various components of typical valve assemblies may experience extensive wear, which can result in premature failure of the valve assembly, see paragraph [0006] of the application.

The problem the invention seeks to solve is to provide a valve, wherein the likelihood of failure of a multi-stage throttling section having first and second throttling components, each comprising one or more throttling discs, is diminished.

This problem is solved by the subject-matter of claim 1 of the main request. In particular, the first throttling component is formed from a hard and brittle material, i.e. a material having a relatively low ductility, that is resistant to wear caused by the flow of abrasive fluids and the second throttling component is formed from a relatively ductile material and is disposed downstream from the first throttling component. The addition of a second throttling component of a more ductile material may provide support of the throttling discs formed from a hard material and greater resistance to cracking of said discs and thus may prevent or at least reduce the possibility of failure of the throttling discs formed from a hard material. If such failure would occur, e.g. when for example the first throttling discs become brittle or cracked, causing portions of said discs to be swept into the fluid flowing, the downstream second throttling disc may retain said portions and block them from migrating further down the fluid flow path.

5.2 Document D1 represents the closest prior art from amongst the documents in the appeal proceedings. This document discloses a valve having all the features of the preamble of claim 1 of the main request.

The subject-matter of claim 1 of the main request differs from the valve known from document D1 in that

- (i) the first throttling component is formed from a first material and the second throttling component is formed from a second material that is different from the first material, wherein the second material is more ductile than the first material, and
- (ii) the second throttling component is disposed downstream from the first throttling component

The distinguishing features (i) and (ii) solve the objective problem of mitigating the likelihood of failure of the multi-stage throttling section, while the distinguishing feature (ii) taken alone solves the problem, if one of the discs of the first throttling component cracks up, of retaining portions of said disc.

Document D1 does not address the problem of failure of the multi-stage throttling section 34, 42. Since document D1 is silent about the ductility of the materials of the disks 34, 42 (see point 4.3 above), this document cannot give the person skilled in the art a hint or suggestion to implement distinguishing feature (i) or (ii) of claim 1 of the main request.

Since document D8 is also silent about the ductility of the materials of the components 96, 100 (see point 4.4 above) there is no hint or suggestion in said document to provide materials for said components that have a different ductility.

- 5.3 It follows from the above that the person skilled in the art, starting from the valve known from document D1, on the basis of his general technical knowledge alone, or in combination with the teaching of document D8, would not have arrived at the subject-matter of claim 1 of the main request in an obvious manner.

Consequently, the subject-matter of claim 1 involves an inventive step with respect to documents D1 and/or D8.

6. *Remittal to the examining division for further prosecution*

- 6.1 The International Search Report cites, apart from document D1 (category X, i.e. a document of particular relevance: the claimed invention cannot be considered novel or to involve an inventive step when the document is taken alone), five other documents in the same category, which are mentioned in point 3 of the International Preliminary Report on Patentability (IPER) issued 26 October 2010. In point 9 of the IPER a further document D7 is mentioned. Apart from documents D1, D6 and D8, none of the other documents appear to have been considered extensively in the European phase of the examination proceedings.

Moreover, the examining division did not take into consideration that the terms "in-line flow passage", "[more] ductile" and "[disposed] downstream" in claim 1 of the main request are technical terms, see points 3

and 4.2 above, which should be taken into account for assessing inventive step, Article 56 EPC.

The board notes that the appellant has not yet filed a complete description and drawings that are in conformity with the set of claims according to the main request.

- 6.2 It is thus considered appropriate to remit the case to the department of first instance for further prosecution, Article 111(1) EPC, with a view to examining inventive step, taking into account all documents D1 through to D8.

## 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 for further prosecution.

The Registrar:

The Chairman:



D. Meyfarth

S. Bridge

Decision electronically authenticated