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Datasheet for the decision of 12 July 2019

Case Number: T 1093/18 - 3.2.01

Application Number: 13167339.4

Publication Number: 2662287

IPC: B64G1/00, B64G1/64

Language of the proceedings: EN

Title of invention:
Multiple space vehicle launch system

Applicant:
The Boeing Company

Headword:

Relevant legal provisions:
EPC Art. 123(2), 56

Keyword:
Amendments - allowable (yes)
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
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Beschwerdekammern

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Case Number: T 1093/18 - 3.2.01

D E C I S I O N
of Technical Board of Appeal 3.2.01
of 12 July 2019

Appellant: (Applicant)	The Boeing Company 100 North Riverside Plaza Chicago, IL 60606-1596 (US)
Representative:	Boult Wade Tennant LLP 5th Floor, Salisbury Square House 8, Salisbury Square London EC4Y 8AP (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 14 November 2017 refusing European patent application No. 13167339.4 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	P. Guntz
Members:	S. Mangin
	S. Hillebrand

Summary of Facts and Submissions

I. The appeal was filed by the appellant (applicant) against the decision of the examining division to refuse the patent application in suit (hereinafter "the application").

II. The examining division decided that claim 1 did not involve an inventive step in view of D10 in combination with D2 or D8.

III. Oral proceedings were held before the Board on 12 July 2019.

IV. The appellant requests that the decision under appeal be set aside and that a patent be granted based on the following documents:
- description pages 1 - 8 submitted during oral proceedings
- claims 1 - 7 submitted during oral proceedings
- drawing sheets 1/3 - 3/3 as originally filed.

V. Claim 1 of the sole request reads as follows:

1. A multiple space vehicle launch system (10), comprising:
a fairing of a launch vehicle;
a first space vehicle (16);
a second space vehicle (18) releasably attached to the first space vehicle (16) and oriented relative to the first space vehicle (16)
such that when the first and second space vehicles are oriented in a stacked manner and placed within a payload region of the fairing (14), a launch load from the first space vehicle (16) is transmitted to and borne by the second space vehicle (18); and

characterised in that the fairing is shaped to enclose the first and the second space vehicles (16, 18), said fairing including a base shaped to support the second space vehicle (18), wherein the second space vehicle rests upon the base which is part of the fairing, and in that the first space vehicle (16) includes a first electrical propulsion unit (40) as the source of propulsion for the first space vehicle and in that the second space vehicle (16) includes a second electrical propulsion unit (40) as the source of propulsion for the second space vehicle,
wherein the first space vehicle (16) includes a first core structure (36) and the second space vehicle (18) includes a second core structure (38), wherein the first core structure (36) engages with and is attached to the second core structure (38), and
wherein the launch load from the first space vehicle (16) is transmitted to the second space vehicle (18) through the first core structure (36) and the second core structure (38), and
wherein the first core structure is cylindrical and hollow, wherein the second core structure is cylindrical and hollow;
wherein the first electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a first tank (44) located within the first core structure; and the second electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a second tank (46) located within the second core structure;
wherein the first space vehicle (16) includes a first shear load panel (32) mounted on the first core structure (18) and a deployable solar array supported by the first shear load panel, and

wherein the second space vehicle (18) includes a second shear load panel (34) mounted on the second core structure (38) and a second deployable solar array supported by the second shear load panel.

VI. Claim 5 of the main request reads as follows:

5. A method of launching a plurality of space vehicles (16,18), the method comprising:
providing a plurality of space vehicles (16,18), including providing a first space vehicle (16) and providing a second space vehicle (18),
wherein the first space vehicles (16) includes a first electrical propulsion unit (40) as the source of propulsion for the first space vehicle and the second space vehicle (16) includes a second electrical propulsion unit (40) as the source of propulsion for the second space vehicle;
orienting the plurality of space vehicles (16,18) in a stacked manner within a payload region (20) of a fairing (14) of a launch vehicle (12) such that gravitational and launch loads of an upper one of the plurality of space vehicles (16,18) is transmitted to and borne by a lower one of the plurality of space vehicles (16,18); and
launching the launch vehicle (12) with the plurality of space vehicles (16,18),
characterised in that the fairing is shaped to enclose the first and the second space vehicles (16,18), said fairing including a base shaped to support the second space vehicle (18), wherein the second space vehicle rests upon the base which is part of the fairing,
wherein orienting the plurality of space vehicles (16,18) includes attaching the first space vehicle (16) to the second space vehicle (18) such that a launch

load of the first space vehicle (16) is transmitted to and borne by the second space vehicle (18), and
wherein attaching the first space vehicle (16) to the second space vehicle (18) includes attaching a first core structure (36) of the first space vehicle (16) to a second core structure (38) of the second space vehicle (18), such that the first core structure (36) is attached to and engages with the second core structure (38) and the launch load of the first space vehicle (16) is transmitted to the second space vehicle (18) through the first core structure (36) and the second core structure (38),
wherein the first core structure is cylindrical and hollow, wherein the second core structure is cylindrical and hollow,
wherein the first electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a first tank (44) located within the first core structure; and the second electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a second tank (46) located within the second core structure;
wherein the first space vehicle (16) includes a first shear load panel (32) mounted on the first core structure (18) and a deployable solar array supported by the first shear load panel, and wherein the second space vehicle (18) includes a second shear load panel (34) mounted on the second core structure (38) and a second deployable solar array supported by the second shear load panel.

VII. In the decision, reference is made to the following documents:
- D2: US5716029 A

- D7: "The European Space Agency's LISA Mission Study: Status and Present Results", U A Johann and Al, 7th Edoardo Amaldi Conference on Gravitational waves, Journal of Physics: Conference Series 122 (2008) 012005.
- D8: "Lisa propulsion module separation study", S M Merkowitz et Al, Institute of Physics Publishing, Class. Quantum Grav 22 (2005) S413-S419.
- D10: "The Cluster Spacecraft: A unique Production Line", G. Mercke, 2521 ESA Bulletin 84, November 1995.

Reasons for the Decision

1. Added subject-matter - Article 123(2) EPC
The amended claims as well as the adapted description comply with the requirements of article 123(2) EPC.

1.1 Basis for the amendments made to claims 1 is provided in parenthesis next to the added features:

1. A multiple space vehicle launch system (10), comprising:
a fairing of a launch vehicle; *(page 5, line 18)*
a first space vehicle (16);
a second space vehicle (18) releasably attached to the first space vehicle (16) and oriented relative to the first space vehicle (16)
such that when the first and second space vehicles are oriented in a stacked manner and placed within a payload region of the fairing (14), a launch load from the first space vehicle (16) is transmitted to and borne by the second space vehicle (18); *(original claim 10)*
and characterised in that the fairing is shaped to enclose the first and the second space vehicles (16, 18), *(original claim 4)*

said fairing including a base shaped to support the second space vehicle (18), *(original claim 5)*
wherein the second space vehicle rests upon the base which is part of the fairing, and *(page 5, lines 32-33)*
in that the first space vehicle (16) includes a first electrical propulsion unit (40) as the source of propulsion for the first space vehicle and in that the second space vehicle (16) includes a second electrical propulsion unit (40) as the source of propulsion for the second space vehicle, *(page 6, lines 16-20)*
wherein the first space vehicle (16) includes a first core structure (36) and the second space vehicle (18) includes a second core structure (38), wherein the first core structure (36) engages with and is attached to the second core structure (38), and *(original claim 7)*
wherein the launch load from the first space vehicle (16) is transmitted to the second space vehicle (18) through the first core structure (36) and the second core structure (38), and *(original claim 8)*
wherein the first core structure is cylindrical and hollow, wherein the second core structure is cylindrical and hollow; *(page 6, line 9)*
wherein the first electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a first tank (44) located within the first core structure; and the second electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a second tank (46) located within the second core structure; *(page 6, lines 16-20)*
wherein the first space vehicle (16) includes a first shear load panel (32) mounted on the first core structure (18) and a deployable solar array supported by the first shear load panel, and *(page 6, lines 5-8 and lines 14-15)*

wherein the second space vehicle (18) includes a second shear load panel (34) mounted on the second core structure (38) and a second deployable solar array supported by the second shear load panel *(page 6, lines 5-8 and lines 14-15).*

1.2 Dependent claim 2 finds basis on page 6, lines 9-14, dependent claim 3 corresponds to original claim 3 and dependent claim 4 corresponds to original claim 11.

1.3 Basis for the amendments made to the method claim 5, originally claim 12, is provided in parenthesis next to the added features:

5. A method of launching a plurality of space vehicles (16,18), the method comprising:
providing a plurality of space vehicles (16,18), including providing a first space vehicle (16) and providing a second space vehicle (18), *(original claim 14)*
wherein the first space vehicles (16) includes a first electrical propulsion unit (40) as the source of propulsion for the first space vehicle and the second space vehicle (16) includes a second electrical propulsion unit (40) as the source of propulsion for the second space vehicle; *(page 6, lines 16-20)*
orienting the plurality of space vehicles (16,18) in a stacked manner within a payload region (20) of a fairing (14) of a launch vehicle (12) such that gravitational and launch loads of an upper one of the plurality of space vehicles (16,18) is transmitted to and borne by a lower one of the plurality of space vehicles (16,18); and
launching the launch vehicle (12) with the plurality of space vehicles (16,18),

characterised in that the fairing is shaped to enclose the first and the second space vehicles (16,18), said fairing including a base shaped to support the second space vehicle (18), *(original claims 4 and 5)*
wherein the second space vehicle rests upon the base which is part of the fairing, *(page 5, lines 32-33)*
wherein orienting the plurality of space vehicles (16,18) includes attaching the first space vehicle (16) to the second space vehicle (18) such that a launch load of the first space vehicle (16) is transmitted to and borne by the second space vehicle (18), and *(original claim 15)*
wherein attaching the first space vehicle (16) to the second space vehicle (18) includes attaching a first core structure (36) of the first space vehicle (16) to a second core structure (38) of the second space vehicle (18), such that the first core structure (36) is attached to and engages with the second core structure (38) and the launch load of the first space vehicle (16) is transmitted to the second space vehicle (18) through the first core structure (36) and the second core structure (38), *(original claims 7, 8 and 16)*
wherein the first core structure is cylindrical and hollow, wherein the second core structure is cylindrical and hollow,*(page 6, line 9)*
wherein the first electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a first tank (44) located within the first core structure; and the second electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a second tank (46) located within the second core structure; *(page 6, l.16-20)*
wherein the first space vehicle (16) includes a first shear load panel (32) mounted on the first core

structure (18) and a deployable solar array supported by the first shear load panel, and *(page 6, lines 5-8 and lines 14-15)*
wherein the second space vehicle (18) includes a second shear load panel (34) mounted on the second core structure (38) and a second deployable solar array supported by the second shear load panel; *(page 6, lines 5-8 and lines 14-15)*.

1.4 Dependent claim 6 finds basis on page 6, lines 10-14, dependent claim 7 corresponds to original claim 13.

2. The subject-matter of claims 1 and 5 involves an inventive step according to Article 56 EPC.

2.1 While the examination division chose D10 as closest prior art, the Board is of the opinion that D7 is a more appropriate starting point for the present set of claims.

2.2 D10 discloses a single vehicle, simultaneously launching four identical spacecraft to investigate the earth's magnetosphere. The cluster spacecraft mission is to investigate the earth magnetosphere from nearly identical, highly elliptical polar orbits using identical instruments on four spacecrafts simultaneously.

The subject-matter of claim 1 differs from D10 in that:
a - the first space vehicle (16) includes a first electrical propulsion unit (40) as the source of propulsion for the first space vehicle and in that the second space vehicle (16) includes a second electrical propulsion unit (40) as the source of propulsion for the second space vehicle,

b - the first electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a first tank (44) located within the first core structure; and the second electrical propulsion unit consists of an ion/plasma motor that utilizes Xenon gas as a propellant that is stored in a second tank (46) located within the second core structure;
c - the first space vehicle (16) includes a first shear load panel (32) mounted on the first core structure (18) and a deployable solar array supported by the first shear load panel, and wherein the second space vehicle (18) includes a second shear load panel (34) mounted on the second core structure (38) and a second deployable solar array supported by the second shear load panel;

This mission foresees that the four satellites will fly in a tetrahedral configuration when crossing the magnetospheric regions of interest. The predefined separation distance between the satellites will be regularly adjusted for the different periods of the two year mission. Each spacecraft therefore has to carry sufficient propellant for all of these manoeuvres (D10, p.1, penultimate paragraph). Moreover high degree of spacecraft electromagnetic cleanliness is required to avoid interference with the measures (D10, p.2, first paragraph).

In view of the above requirements, the skilled person would not look into using electrical propulsion units as electrical propulsion units having a lower thrust compared to chemical propulsion units which implies longer time to adjust the separation distance between the satellites. Moreover electrical propulsion units may lead to electromagnetic contamination.

D10 does not therefore constitute a promising starting point for a development leading to the invention. And for the above reasons the person skilled in the art when nevertheless starting from D10 would not arrive at the claimed invention.

2.3 D7 relates to the European Space Agency's LISA Mission Study. The subject-matter of claim 1 differs from the multiple space vehicle launch system of the LISA mission D7 with regard to features a, b and c mentioned above.

Electrical propulsion units expend less propellant for a given thrust than chemical propulsion units and thus require less propellant.

The arrangement of the space vehicles comprising a hollow core structure with shear load panels and deployable solar array eliminates the need for an inner fairing structure.

The problem to be solved may be regarded as to reduce the payload mass in the fairing.

While reducing the payload mass is a constant requirement in space vehicle launch systems and while in the LISA mission an arrangement of the space vehicles has been developed to eliminate the need for an inner fairing structure (see D7, figure 6), and electrical propulsion units have been envisaged for the propulsion module (see D8, p.414, second paragraph), whereby an ion/plasma motor that utilizes Xenon gas is a well known electrical propulsion motor, the present invention defines a non obvious alternative way of solving the above mentioned problem.

Starting from D7, the skilled person would not arrive at the alternative solution proposed by claim 1. In the Lisa mission, the structural core is a hollow cylinder placed on the periphery of the space vehicle and the solar array is a disc placed on top of the space vehicle. There is no incentive for the skilled person to change this configuration to the one of the present invention, which would require placing the outer structural core in a more central position, attaching shear panels and replacing the disc of solar arrays on top of the space vehicle with deployable solar arrays placed on the shear panels. While these changes may theoretically be carried out, only an ex-post facto analysis can lead the skilled person to carry out the necessary changes.

Thus starting from the multiple space vehicle launch system of the LISA mission, the skilled person would not have arrived at the subject-matter of claim 1 without inventive skills especially in view of feature c.

2.4 The above reasoning applies mutatis mutandis to the method claim 5.

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 based on the following documents:

   Description:
   Pages 1 - 8 received during oral proceedings of 12 July 2019

   Claims:
   No. 1 - 7 received during oral proceedings of 12 July 2019

   Drawings:
   Sheets 1/3 - 3/3 as originally filed.

The Registrar: The Chairman:

A. Pinna P. Guntz

Decision electronically authenticated