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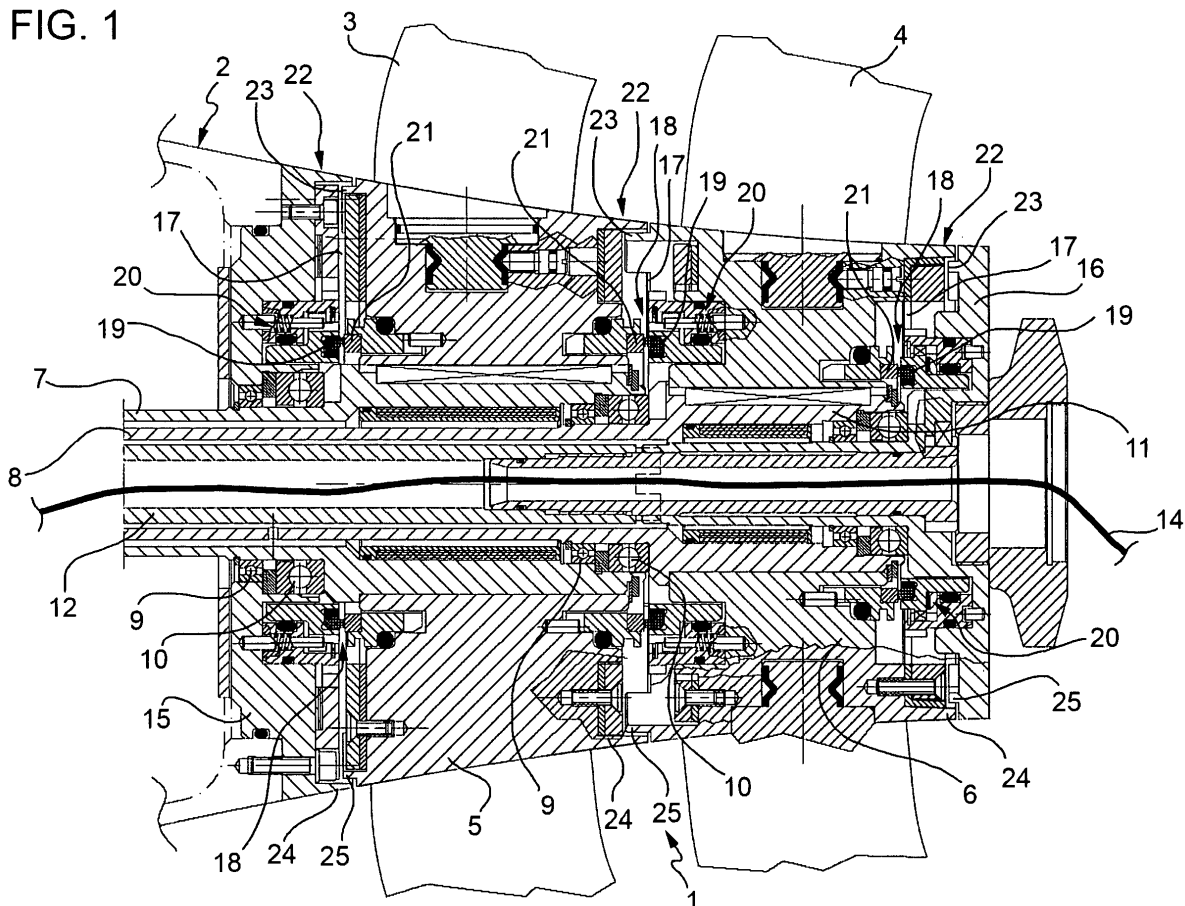
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(54) **Wire-guided torpedo propulsion assembly**

(57) A propulsion assembly (1) for a torpedo (2) equipped with a wire-guidance cable (14), the assembly having at least two parts (15, 5; 5, 6; 6, 16) in relative

rotational motion; face sealing means (18) interposed between the parts (15, 5; 5, 6; 6, 16); and protection means (22) for preventing access of the cable (14) to the face sealing means (18).

FIG. 1



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Description

[0001] The present invention relates to a wire-guided torpedo propulsion assembly.

[0002] A torpedo propulsion assembly normally comprises two counter-rotating propellers with respective hubs driven by coaxial shafts. The axially adjacent hubs are mounted between two axial covers - one front and one rear; and, to prevent water from entering between the parts in relative motion, sliding face seals are provided, normally comprising a graphite ring sliding on a tungsten carbide surface.

[0003] Wire-guidance systems are also known comprising an optical-fibre cable wound partly on a reel inside the torpedo, and partly on a reel integral with the launcher. The cable extends along a cable duct extending inside the innermost (rear) propeller shaft, to allow dialoging between the launcher and the torpedo. This system enables distancing of the torpedo and the launcher with no significant increase in load on the cable, which is therefore maintained below break load at all times.

[0004] The wire-guidance cable is unwound gradually as the torpedo advances. The wire-guidance cable is normally of slightly negative buoyancy (hydrostatic thrust - weight) and so tends to either remain stationary or sink very slowly.

[0005] In the event of the torpedo trajectory passing close to the unwinding cable, the rotating propellers may engage the cable and wind it onto the face seals; in which case, the cable may interpose itself between the graphite ring and the sealing surface, thus allowing water into the torpedo.

[0006] It is an object of the present invention to provide a wire-guided torpedo propulsion assembly designed to eliminate the above drawback.

[0007] According to the present invention, there is provided a wire-guided torpedo as claimed in Claim 1.

[0008] A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an axial section of a propulsion assembly in accordance with the invention;

Figures 2, 3, 4 and 5 show views in perspective of component parts of the Figure 1 assembly.

[0009] Number 1 in Figure 1 indicates as a whole a propulsion assembly of a wire-guided torpedo 2 (only shown partly).

[0010] Assembly 1 comprises two propellers 3, 4 mounted on respective front and rear hubs 5, 6 fitted to respective coaxial, counter-rotating shafts 7, 8.

[0011] Shafts 7, 8 are driven by an electric motor (not shown) by means of a known drive, also not shown by not forming part of the present invention.

[0012] Shafts 7, 8 are hollow, and are fitted one inside the other by means of conventional radial bearings 9 and thrust bearings 10 not described in detail.

[0013] Front hub 5 is fitted to the outer shaft 7, and rear hub 6 is fitted to an end portion 11 of the inner shaft 8 projecting axially from shaft 7.

[0014] Inner shaft 8 houses a cable duct 12, along which unwinds a wire-guidance cable 14 wound into a reel (not shown) housed in the body of torpedo 2.

[0015] Hubs 5, 6 are axially adjacent and mounted between an annular front cover 15 fixed rigidly to the body of torpedo 2, and an annular rear cover 16 fixed to one end of cable duct 12. The two covers 15, 16 thus close propulsion assembly 1 axially.

[0016] An axial clearance defining a gap 17 is present between each two parts in relative motion (front cover 15 - front hub 5; front hub 5 - rear hub 6; rear hub 6 - rear cover 16). And, to prevent water entering the torpedo through gap 17, a known sliding face seal assembly 18 is provided between the parts in each pair.

[0017] More specifically, each seal assembly 18 comprises an annular seal 19 made of material with a low friction coefficient, e.g. graphite, and secured in known manner to one of the parts in the pair by an elastic device 20; and a ring 21 made of extremely hard, wear-resistant material, e.g. tungsten carbide, and fitted to the other of the parts in relative motion. Elastic device 20 - not described in detail as not forming part of the present invention - exerts axial thrust on seal 19 to hold it in contact with ring 21.

[0018] According to the present invention, to prevent wire-guidance cable 14 from penetrating gap 17 and interposing itself between seal 19 and ring 21, thus separating them and impairing sealing performance, protection means 22 defining a labyrinth 23 are provided on the outside of gaps 17.

[0019] Protection means 22 conveniently comprise a circumferential edge 24, which extends axially from one of the parts in relative motion (the front part, i.e. closer to the torpedo head), and extends flush with the outer profile of the torpedo, in the opposite direction to the travelling direction of the torpedo; and a corresponding inner circumferential projection 25, which extends axially from the other of the parts in relative motion (the rear part, i.e. closer to the rear of the torpedo), extends in the travelling direction of the torpedo, and is coaxial with and radially faces edge 24 to form labyrinth 23 with edge 24.

[0020] As opposed to being circumferentially continuous, inner projection 25 is preferably defined by a number of, e.g. four, sectors 26 equally spaced angularly to define an axially symmetrical structure.

[0021] Figure 2 shows front cover 15 with edge 24.

[0022] Figure 3 shows front hub 5, which, at the front, has sectors 26 cooperating with edge 24 of front cover 15, and has edge 24 at the rear.

[0023] Figure 4 shows rear hub 6, which, at the front, has sectors 26 cooperating with edge 24 of front hub 5, and has edge 24 at the rear.

[0024] Figure 5 shows rear cover 16 with sectors 26 at the front cooperating with edge 24 of rear hub 6.

[0025] Sectors 26 prevent passage of cable 14.

[0026] To reach sealing assembly 18, wire-guidance cable 14 would have to change direction three times. That is, to negotiate labyrinth 23, it would have to move radially to penetrate, then continue in an axial direction, and, finally, move once more radially with respect to the axis of torpedo 2, and all this while propellers 3, 4 are rotating. The likelihood of this occurring is substantially zero.

[0027] Assuming the cable manages to slip inside the first portion of the path of labyrinth 23, sectors 26 act as a reel about which cable 14 can wind without compromising the seals.

[0028] The fact that projection 25 comprises a number of separate sectors 26, as opposed to being continuous, allows fresh water, when washing, to reach the seals, and does not affect the cooling and lubrication condition of the seals.

[0029] Being axially symmetrical, protection means 22 induce no static or dynamic unbalance of the rotating parts, and produce no noise during rotation. Edges 24, flush with the outer profile of torpedo 2, also assist in maintaining a low noise level.

[0030] Clearly, changes may be made to propulsion assembly 1 as described herein without, however, departing from the protective scope as defined in the accompanying Claims.

Claims

1. A propulsion assembly (1) for a torpedo (2) equipped with a wire-guidance cable (14), the assembly comprising at least two parts (15, 5; 5, 6; 6, 16) in relative rotational motion; and face sealing means (18) interposed between said parts (15, 5; 5, 6; 6, 16); and being **characterized by** comprising protection means (22) for preventing access of said cable (14) to said face sealing means (18).
2. An assembly as claimed in Claim 1, **characterized in that** said protection means (22) define a labyrinth (23).
3. An assembly as claimed in Claim 1 or 2, **characterized in that** said protection means (22) comprise a circumferential edge (24) extending in a substantially axial direction from one of said at least two parts (15; 5; 6); and at least one circumferential projection (25) extending axially from the other part (5; 6; 16) and radially facing said edge (24).
4. An assembly as claimed in Claim 3, **characterized in that** said edge (24) is flush with an outer profile of said propulsion assembly (1) and faces the opposite way to the travelling direction of the torpedo (2).
5. An assembly as claimed in Claim 4, **characterized in that** the projection (25) is located radially inwards

with respect to said edge (24), and extends axially in the travelling direction of the torpedo (2).

6. An assembly as claimed in one of Claims 3 to 5, **characterized in that** said projection (25) is defined by a number of angularly spaced sectors (26).
7. An assembly as claimed in Claim 6, **characterized in that** said sectors (26) are arranged axially symmetrically.
8. An assembly as claimed in any one of the foregoing Claims, **characterized in that** at least one of said parts (5; 6) is a hub of a propeller (3; 4).
9. An assembly as claimed in Claim 8, **characterized in that** at least one of said parts is an axial cover (15; 16) of said propulsion assembly (1).
10. An assembly as claimed in Claim 9, **characterized in that** said parts in relative rotational motion comprise two axially adjacent, counter-rotating hubs (5, 6), and two fixed covers (15, 16) located on axially opposite sides of said hubs (5, 6); said protection means (22) being provided between each two axially adjacent said parts (15, 5; 5, 6; 6, 16) in relative rotational motion.

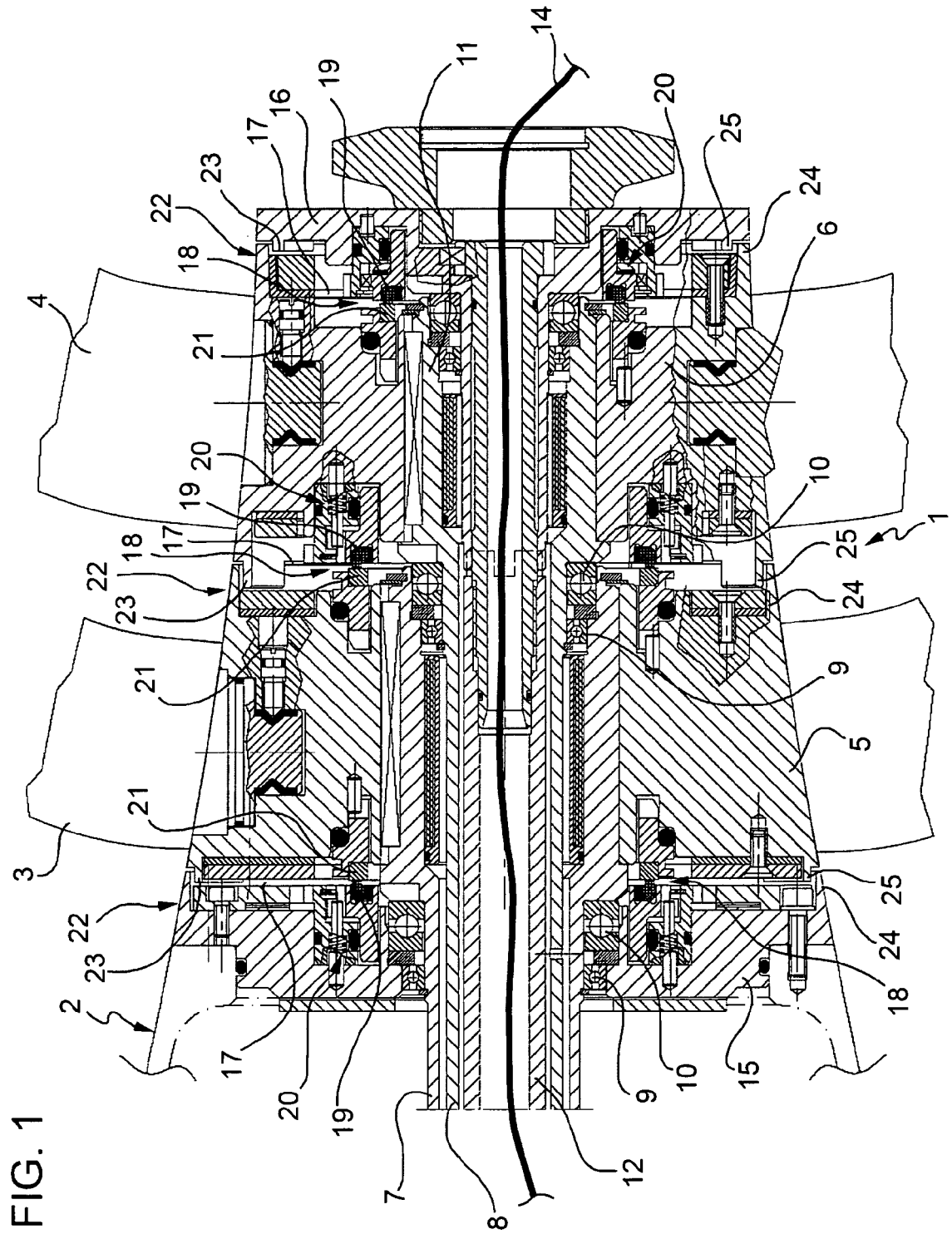


FIG. 1

FIG. 2

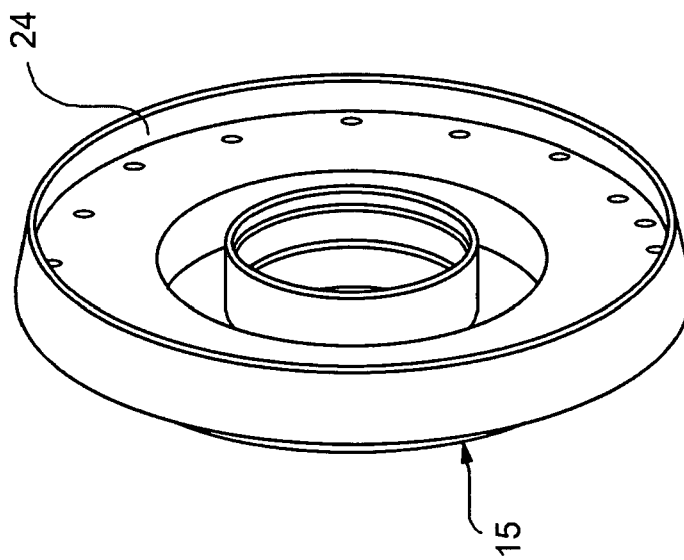


FIG. 3

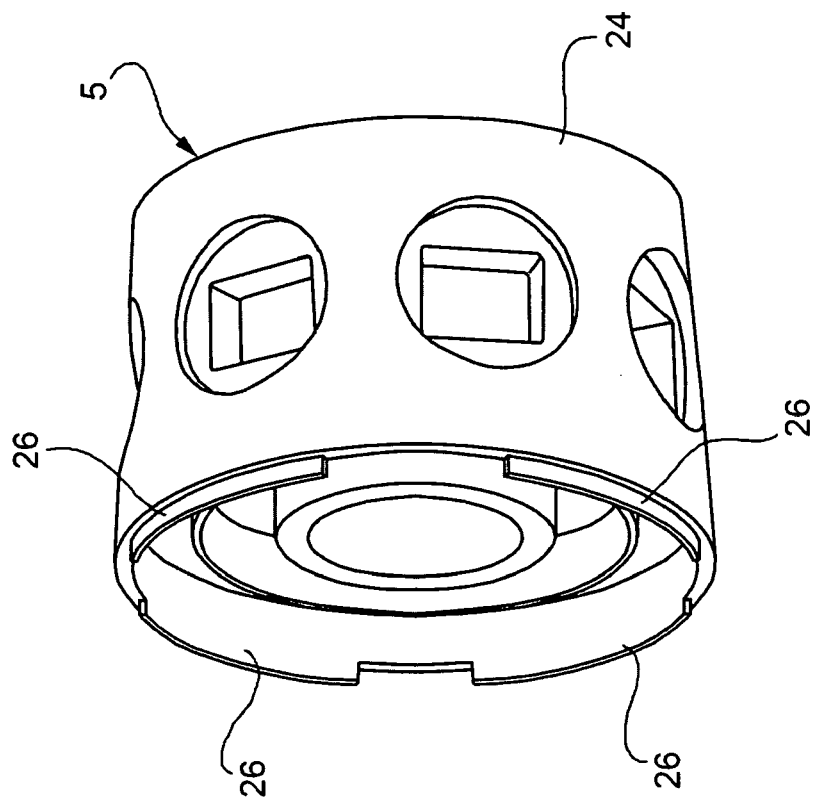


FIG. 5

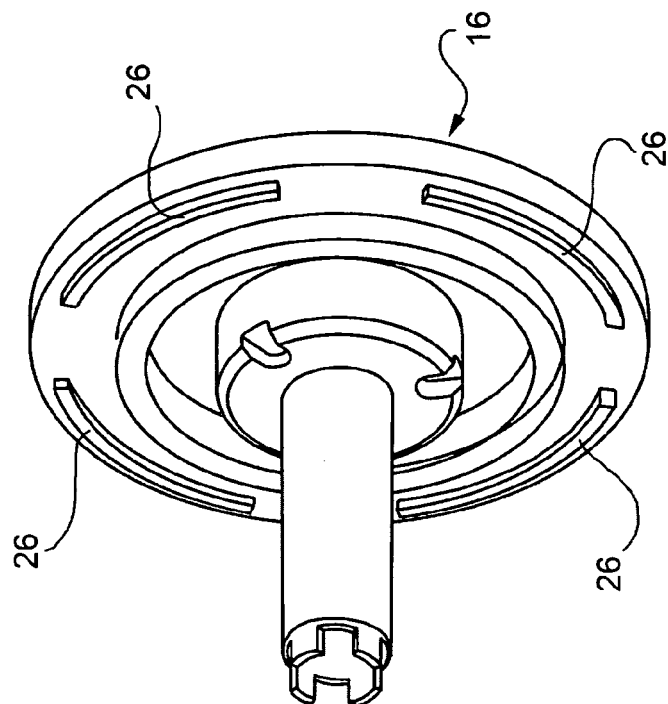
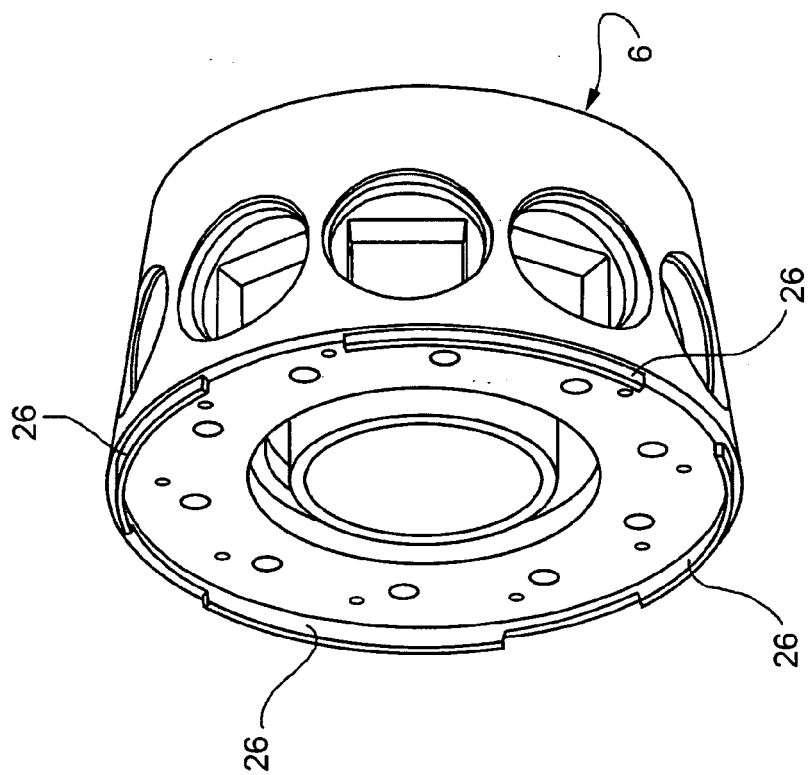


FIG. 4





EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5232

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 637 825 A (GLENNING DANIEL M [US]) 10 June 1997 (1997-06-10) * abstract *	1	INV. F41G7/32 F42B15/04
A	* column 4, line 11 - column 6, line 18; figure *	2-10	
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A	* column 2, line 38 - column 5, line 2; figures 1-3 *	2-10	
X	DE 38 18 840 C1 (DEUTSCHE AEROSPACE [DE]) 20 January 1994 (1994-01-20) * abstract *	1	
A	* column 1, line 56 - column 3, line 29; figures 1-4 *	2-10	
X	EP 0 504 049 A (FRANCE ETAT [FR]) 16 September 1992 (1992-09-16) * abstract *	1	TECHNICAL FIELDS SEARCHED (IPC) F41G F42B
A	* page 5, column 7, line 58 - page 7, column 11, line 1; figures 1-3 *	2-10	
X	US 5 678 785 A (PORTER DAVID R [US]) 21 October 1997 (1997-10-21) * abstract *	1	
A	* column 3, line 66 - column 7, line 65; figures 1-12 *	2-10	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 October 2008	Examiner Blondel, François
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 42 5232

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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