(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 February 2005 (17.02.2005)

PCT

(10) International Publication Number
WO 2005/015044 A1

(51) International Patent Classification[7]: F16D 55/46, 65/14

(21) International Application Number: PCT/GB2004/003023

(22) International Filing Date: 12 July 2004 (12.07.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0317908.2 31 July 2003 (31.07.2003) GB

(71) Applicant *(for all designated States except US)*: **SMITHS GROUP PLC** [GB/GB]; 765 Finchley Road, London NW11 8DS (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **DAVIES, Jonathan, Paul** [GB/GB]; 7 Kentish Close, Western Downs, Stafford, Staffordshire ST17 9QZ (GB). **FARLEY, Brian** [GB/GB]; The Firs, Burrups Lane, Gorsley, Ross-on-Wye, Herefordshire HR9 7FA (GB). **TYLER, Neil, Christian** [GB/GB]; 36 Idonia Road, Perton, Wolverhampton WV6 7NQ (GB). **VENABLES, Neil, Andrew** [GB/GB]; 58 Woodthorpe Drive, Bewdley, Worcestershire DY12 2RH (GB).

(74) Agent: **FLINT, Jonathan, McNeill**; 765 Finchley Road, London NW11 8DS (GB).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

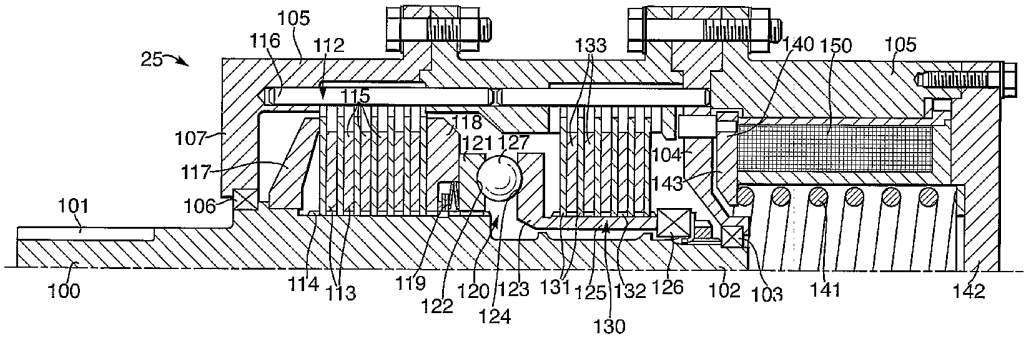
Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i)) for all designations*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,*

[Continued on next page]

(54) Title: BRAKES



(57) Abstract: An aircraft wing tip brake assembly (25) for braking rotation of a shaft (23, 100) has a casing (105) enclosing a first, main brake (112) with two sets of brake plates (113, 115) mounted respectively with the shaft and the casing. Force can be applied to actuate the main brake (112) by a ball ramp mechanism (120), a first plate (121) of which is connected with the main brake and a second plate (123) of which is connected with a set of brake plates (131) in a secondary brake (130). The secondary brake (130) has a second set of brake plates (133) mounted with the casing (105). A spring (141) in an electric actuator applies force to urge together the two sets of brake plates (131) and (133) in the secondary brake (130) and thereby apply the second brake to prevent rotation of the second plate (123) of the ball ramp mechanism (120). This, in turn, causes the first plate (121) to move towards the main brake (112) thereby causing it to apply a breaking force between the shaft (10) and the casing (105). To release the brake assembly (25), power is supplied to the actuator windings (150), which applies force against the spring (140) to release both the secondary brake (130) and the main brake (112).

WO 2005/015044 A1

MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— *of inventorship (Rule 4.17(iv)) for US only*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BRAKES

This invention relates to brake assemblies of the kind including a casing and a first brake coupled between a shaft and the casing.

The invention is more particularly, but not exclusively, concerned with wing tip brakes.

An aircraft high lift system, such as including a flap or slat is often displaced by mechanical actuators powered by rotation of a shaft extending along the length of the wing and driven by a motor towards the aircraft body. The shaft system may be provided with a brake towards the wing tip. The brake is applied to stop rotation of the shaft and hence movement of the control surfaces if an anomaly is detected in the drive system, to protect against asymmetry of the control surfaces in the drive systems on the two wings. The brake may be hydraulically operated but this requires hydraulic piping and electrical control wiring to extend along the length of the wing, which adds to the weight and cost. Electrically-operated solenoid brakes may alternatively be used but those capable of stopping rotation of the shaft are large and heavy. Electrically-operated brakes including a ball ramp mechanism have been proposed. These can be lighter and smaller than conventional electrical brakes but, as previously proposed, they need to be manually released after actuation. In an aircraft, this would mean that, once operated, the brakes would be locked on and the control surfaces could not be moved until the aircraft had landed.

It is an object of the present invention to provide an alternative brake.

According to one aspect of the present invention there is provided a brake assembly of the above-specified kind, characterised in that the assembly includes a ball ramp mechanism having a first part coupled with the first brake, a second brake coupled to a second part of the ball ramp mechanism, and an actuator operable to apply a force to the second brake such as to slow movement of the second part of the ball ramp mechanism and thereby cause the first part of the ball ramp mechanism to apply a force to the first brake so as to brake rotation of

the shaft, and such that the braking force on the shaft releases when the actuator ceases applying the force to the second brake.

The actuator is preferably electrical and may include an armature and electrical windings. The actuator preferably includes a resilient member operable to apply the force to the second brake. The actuator is preferably arranged to apply force to the second brake in the absence of electrical power to the actuator. The first brake may include a plurality of brake plates some of which are mounted with the casing and others of which are mounted with the shaft, the ball ramp mechanism being operable to apply a force urging the brake plates together and thereby apply a braking force to the shaft. The second brake may include a plurality of brake plates some of which are mounted with the casing and others of which are mounted with the ball ramp mechanism. The ball ramp mechanism preferably includes two parallel, spaced plates with a plurality of arc shaped grooves on opposed faces, the grooves being deepest towards a midpoint along their length and being shallower towards their ends, the mechanism including a ball retained between respective grooves in the two plates. The shaft may be coupled to a control surface of an aircraft wing.

According to another aspect of the present invention there is provided an aircraft control surface mechanism including first and second shafts extending along a part of the length of respective wings of an aircraft, a control surface coupled with each shaft, a drive for rotating the shafts about their length to effect movement of the respective control surface, an anomaly detector for sensing an anomaly in operation of the mechanism, and first and second brake assemblies connected with respective ones of the first and second shafts, each brake assembly including a casing and a first brake coupled between the respective shaft and the casing, characterised in that the brake mechanism includes a ball ramp mechanism having a first part coupled with the first brake, a second brake coupled to a second part of the ball ramp mechanism, and an actuator operable in response to an output from the anomaly detector to apply a force to the second brake such as to slow movement of the second part of the ball ramp mechanism and thereby cause the first part of the ball ramp mechanism to apply a force to the first brake so as to brake rotation of the shaft and thereby prevent further displacement of the control surface, and such that the braking force on the shaft releases when the actuator ceases applying the force to the second brake.

An aircraft wing tip brake assembly according to the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a simplified, plan view of an aircraft flap system including a brake assembly on each wing;

Figure 2 is a sectional side elevation view through one half of a brake assembly; and

Figure 3 illustrates a plate of the ball ramp mechanism.

With reference first to Figure 1, the aircraft has two wings 1 and 2 extending laterally from opposite sides of its body 3. Each wing supports two lift flaps 11 and 12, and 21 and 22 respectively on its trailing edge, which are extensible and deflectable to increase the lift provided by the wings such as during take-off and landing. The flaps 11 and 12 on one wing 1 are coupled to a single shaft 13 extending along the major part of the length of the wing 1 parallel to and adjacent its trailing edge. The coupling between the shaft 13 and the flaps 11 and 12 includes gearing (not shown), which steps down multiple rotations of the shaft into an angular displacement of the flaps. Similarly, the right wing 2 has a shaft 23 extending along its length coupled to the flaps 21 and 22. The shafts 13 and 23 are rotated by a common drive unit 14 mounted at the inboard end of the shafts adjacent the body 3. The drive unit 14 is controlled by a control unit 30.

Mounted at the outer end of each shaft 13 and 23, towards the tip of each wing 1 and 2, there is a brake assembly 15, 25, which is also controlled by signals from the control unit 30. In particular, the control unit 30 supplies signals to actuate the brakes 15 and 25 when it detects an anomaly in displacement of the flaps 11, 12, 21 and 22 or their associated mechanism inconsistent with the displacement commanded, or when there is asymmetry between operation of the flaps on the two wings. This locks the shafts 13 and 23 to prevent further displacement of the flaps 11, 12, 21 and 22. Sensors 31 located adjacent the shafts 13

and 23 or the flaps 11, 12, 21 and 22 supply signals to the control unit 30 for use in identifying an anomaly.

With reference now to Figures 2 and 3 the construction and operation of the brake assembly 25 will be described; the construction and operation of the other brake 15 is identical.

The brake assembly 25 includes an inner, axial shaft 100 of tubular form and cut with splines 101 on its outer surface at one end. These splines 101 are shaped to mate with similar splines (not shown) in a recess at the wing tip end of the shaft 23 so that the two shafts 100 and 23 rotate together. The shaft 100 is supported at its right-hand end 102 by a bearing 103 mounted on a flange 104 fixed with the outer casing 105 of the assembly. The casing 105 is generally cylindrical in shape and is formed of several parts held together by nuts and bolts. The outer casing 105 is fixed to the structure of the wing 2 so that it cannot move relative to the wing. A second bearing 106 supports the shaft 100 towards its opposite end, just to the right of the splines 101. The second bearing 106 is fixed with a left-hand end flange 107 of the casing 105.

The left-hand end of the casing 105 contains a main brake unit 112. This comprises a number of brake plate rotors 113 mounted by splines 114 on the shaft 100 so that they rotate with the shaft but can be displaced by a small distance axially along the shaft. Between each rotor plate 113 extends a respective stator plate 115, which are mounted on longitudinally-extending rods 116 fixed with the casing 105. The mounting prevents the stator plates 113 rotating but they can slide along the rods by a small distance. The brake plates 113 and 115 are contained at one end by a flange 117 fixed with the shaft 100 to the left of the plates. At their opposite end, the plates 113 and 115 are contacted by a second flange 118, which is slidable along the splines 114. A disc spring mechanism 119 towards the right-hand end of the brake plates 113 and 115 holds them apart, so that no braking force is applied, until an external force is applied to push them together.

The right-hand end flange 118 is engaged by a ball ramp mechanism 120. This comprises a first plate 121 in contact with the flange 118 and slidable along the splines 114.

The right-hand surface of the plate 121 has three grooves 122 of arc shape equally spaced around the plate and with their centre of curvature at the centre of the plate. Each groove 122 is symmetrical about a radial line bisecting the groove and is deepest midway along its length, becoming shallower towards each end. The mechanism 120 includes a second plate 123 having three grooves 124 on its left-hand surface, that is, the face opposed to the grooved face of the first plate 121, the grooves being of the same form as those on the first plate 121.The second plate 123 is provided at the left-hand end of a tubular sleeve 125, which is supported at its right-hand end by a bearing 126 so that it is free to rotate about the axis of the shaft 100 but cannot move axially relative to the shaft. The ball ramp mechanism 120 also includes three spherical metal bearing balls 127 between the two plates 121 and 123 and located in the grooves 122 and 124. The inclination of the two grooves 122 and 124 at their ends are such that when the two plates 121 and 123 are rotated relative to one another the trapped balls 127 ride up the slope of the grooves in the two plates causing the plates to separate. The left-hand plate 121 is constrained to rotate with the shaft 100 whereas the right-hand plate 123 is unconstrained and can rotate relative to the shaft but normally will be rotated with the left-hand plate.

A secondary brake unit 130 is located to the right of the ball ramp mechanism 120. This is similar to the main brake unit 112 but is only capable of applying a much smaller braking force. The secondary brake unit 130 includes several brake rotor plates 131 mounted on longitudinally-extending splines 132 around the external surface of the sleeve 125 so that the plates rotate with the sleeve and can be moved a small distance along the length of the sleeve. The stator brake plates 133 are mounted on the rods 116 fixed with the casing 105 so that they cannot rotate but can be displaced a small distance axially. The right-hand end of the stack of brake plates 131 and 133 is engaged by the left-hand end of a cylindrical, soft-iron armature assembly 140, which is slidable axially of the brake assembly 25. The armature assembly 140 is urged to the left by a helical spring 141 extending between an end flange 142 of the outer casing 105 and between a flange 143 towards the left-hand end of the armature. The force applied by the spring 141, therefore, tends to apply a braking force between the two sets of brake plates 131 and 133 in the secondary brake unit 130. The armature assembly 140 interacts electromagnetically with two electrical winding coils 150 fixed to the inside of the casing 105 so that the combination of the armature and coils provides actuation means in the

form of an electrical solenoid. The coils 150 and armature 140 form an actuator and are arranged so that when power is applied to the coils it causes an axial force on the armature acting against that of the spring 141, that is, tending to move the armature to the right. It can be seen, therefore, that when power is applied to the windings 150 the secondary brake 130 is off and when no power is applied, the secondary brake is on. Alternative forms of actuator could be used.

In normal operation of the aircraft, the control unit 30 applies power to the windings 150 in each brake assembly 15 and 25 so that the secondary brake 130 is held off. This allows the two plates 121 and 123 to rotate together and assume a configuration with minimum separation between them. This in turn ensures that no force is applied against the action of the spring 119 in the main brake unit 112 so that plates 113 and 115 of this brake unit are free to rotate relative to one another and no braking force is applied to the shaft 100. The shafts 13 and 23 are, therefore, free to rotate to displace the flaps 11, 12, 21 and 22 as commanded.

When an anomaly is detected, such as asymmetry between the displacement of the flaps or shafts in opposite wings, the control unit 30 immediately terminates supply of power to each brake assembly 15 and 25. The spring 141 is now free to displace the armature 140 to the left, which applies a force pushing the stator and rotor brake plates 133 and 131 together. This increases friction between the plates 133 and 131 and applies a braking force between the casing 105 and the sleeve 125. The sleeve 125 and the plate 123, therefore, stop rotating. The other plate 121 of the ball mechanism 120 continues to rotate through a small angle causing the balls 127 to ride up the incline of the grooves 122 and 124 and force the two plates apart. Since the right-hand plate 123 is fixed axially, all the displacement is produced in the left-hand plate 121. Movement of this plate 121 is transferred to the flange 118 and hence to the brake plates 113 and 115 of the main brake unit 112. The expansion and force applied by the ball ramp mechanism 120 is sufficient fully to apply the main brake 112 and prevent rotation of the shaft 100. This in turn brakes rotation of the shafts 13 and 23 so that the flaps 11, 12, 21 and 22 are locked in position. The flaps 11, 12, 21 and 22 remain locked as long as the brake assemblies 15 and 25 are on. When the flaps 11, 12, 21 and 22 need to be released, the control unit 30 supplies power to each brake assembly 15 and 25 to energize the coils 150 and pull the armature 140 against the action of the spring 141 to release the

secondary brake unit 130. The right-hand plate 123 of the ball ramp 120 can now rotate to allow the balls 127 to ride down the ramp of the grooves 122 and 124, aided by the spring 119, and thereby allow the left-hand plate 121 to move towards the other plate and release the braking force applied by the main brake unit 112 so that the shaft 100 can rotate freely.

The braking force that stops rotation of the shaft 100 is applied solely by the main braking unit 112 and the casing 105. The axial load generated by the ball ramp mechanism 120 is contained within the braking unit 112 and the shaft 102 and does not influence the braking unit 130. This ensures that there is no risk of self-generated forces jamming the ball ramp mechanism 120. This arrangement enables the brake assembly to be released electrically, remotely without the need for manual unlocking.

The assembly of the present invention can be relatively compact and of low weight whilst still providing sufficient force rapidly to brake movement of the control surfaces.

It will be appreciated that the assembly is not confined to use in aircraft but could be used for braking other rotating mechanisms. The brake assembly could readily be arranged to be normally off and be turned on when power is supplied to it.

CLAIMS

1. A brake assembly including a casing (105) and a first brake (112) coupled between a shaft (100) and the casing, characterised in that the assembly includes a ball ramp mechanism (120) having a first part (121) coupled with the first brake (112), a second brake (130) coupled to a second part (123) of the ball ramp mechanism, and an actuator (140, 141, 150) operable to apply a force to the second brake (130) such as to slow movement of the second part (123) of the ball ramp mechanism (120) and thereby cause the first part (121) of the ball ramp mechanism to apply a force to the first brake (112) so as to brake rotation of the shaft (100), and such that the braking force on the shaft releases when the actuator (140, 141, 150) ceases applying the force to the second brake (130).

2. A brake assembly according to Claim 1, characterised in that the actuator (140, 141, 150) is electrical.

3. A brake assembly according to Claim 2, characterised in that the actuator includes an armature (140) and electrical windings (150).

4. A brake assembly according to any one of the preceding claims, characterised in that the actuator includes a resilient member (141) operable to apply the force to the second brake (130).

5. A brake assembly according to any one of the preceding claims, characterised in that the actuator (140, 141, 150) is arranged to apply force to the second brake (130) in the absence of electrical power to the actuator.

6. A brake assembly according to any one of the preceding claims, characterised in that the first brake (112) includes a plurality of brake plates some of which (115) are mounted with the casing (105) and others of which (113) are mounted with the shaft (100), and that the ball ramp mechanism (120) is operable to apply a force urging the

brake plates (113 and 115) together and thereby apply a braking force to the shaft (100).

7. A brake assembly according to any one of the preceding claims, characterised in that the second brake (130) includes a plurality of brake plates (131, 133) some of which are mounted with the casing (105) and others of which are mounted with the ball ramp mechanism (120).

8. A brake assembly according to any one of the preceding claims, characterised in that the ball ramp mechanism (120) includes two parallel, spaced plates (121, 123) with a plurality of arc shaped grooves (122, 124) on opposed faces, that the grooves are deepest towards a midpoint along their length and are shallower towards their ends, and that the mechanism includes a ball (127) retained between respective grooves in the two plates.

9. A brake assembly according to any one of the preceding claims, characterised in that the shaft (100) is coupled to a control surface (11, 12, 21, 22) of an aircraft wing (1, 2).

10. An aircraft control surface mechanism including first and second shafts (13 and 23) extending along a part of the length of respective wings (1, 2) of an aircraft, a control surface (11, 12 and 21, 22) coupled with each shaft, a drive (14) for rotating the shafts about their length to effect movement of the respective control surface, an anomaly detector (30, 31) for sensing an anomaly in operation of the mechanism, and first and second brake assemblies (15, 25) connected with respective ones of the first and second shafts (13 and 23), each brake assembly including a casing (105) and a first brake (112) coupled between the respective shaft and the casing, characterised in that the brake mechanism (15, 25) includes a ball ramp mechanism (120) having a first part (121) coupled with the first brake (112), a second brake (130) coupled to a second part (123) of the ball ramp mechanism, and an actuator (140, 141, 150) operable in response to an output from the anomaly detector (30, 31) to apply a force to the second brake (130) such as to slow movement of the second part (123) of the

ball ramp mechanism (120) and thereby cause the first part (121) of the ball ramp mechanism to apply a force to the first brake (112) so as to brake rotation of the shaft (100, 13, 23) and thereby prevent further displacement of the control surface (11, 12, 21, 22), and such that the braking force on the shaft releases when the actuator ceases applying the force to the second brake.

Fig.1.

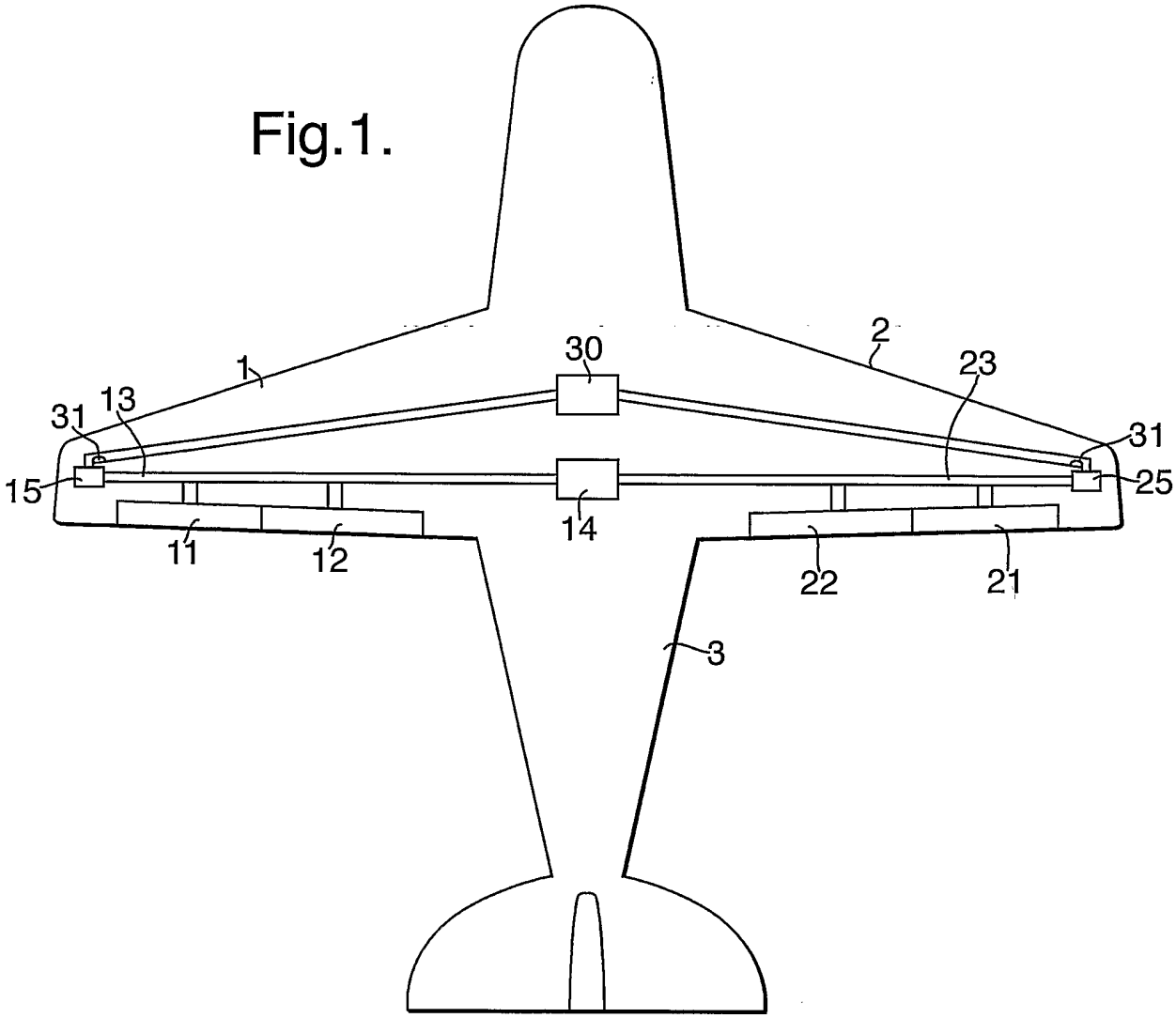


Fig.3.

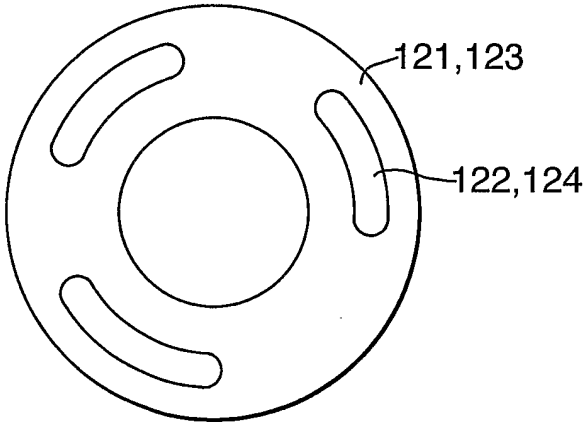
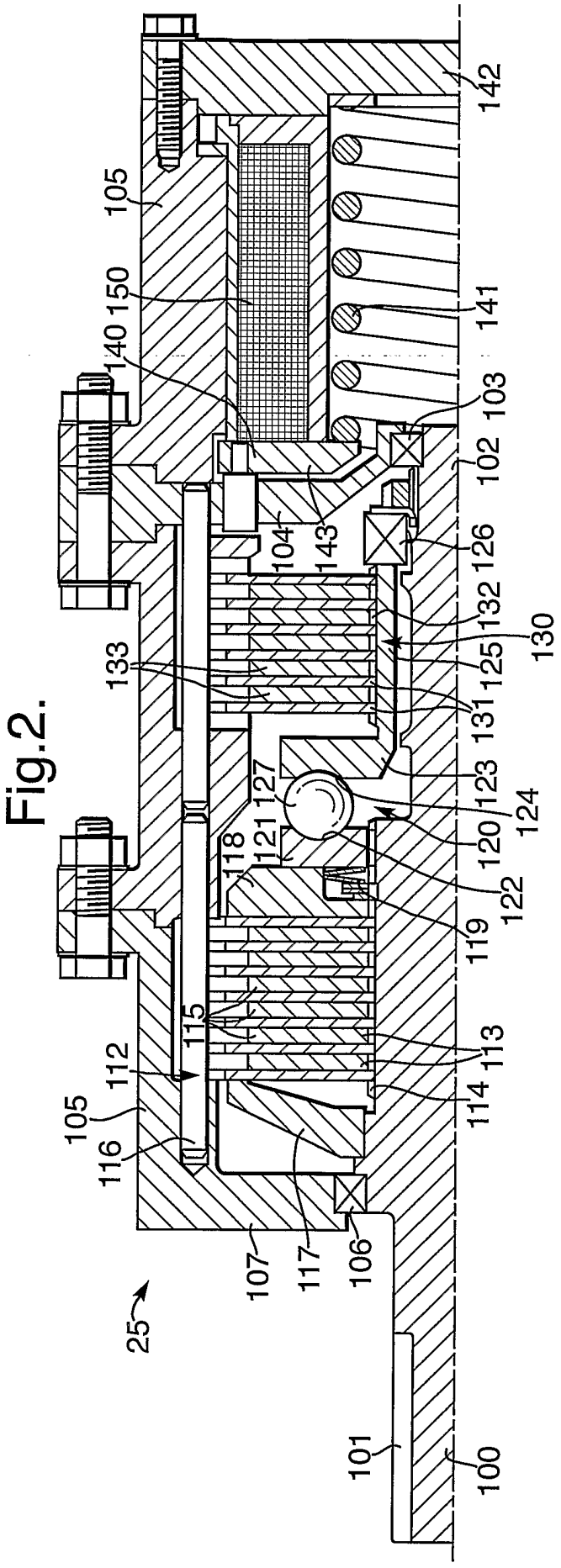


Fig.2.


142
105
150
141
140
103
102
143
104
126
132
130
133
125
131
123
127
124
121
120
118
122
119
115
113
112
114
105
116
107
117
106
25
101
100

INTERNATIONAL SEARCH REPORT

International Application No
./GB2004/003023

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16D55/46 F16D65/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 081 405 A (LUCAS INDUSTRIES LTD) 7 March 2001 (2001-03-07) column 3, paragraph 16 - column 5, paragraph 25; figures 1,2	1-9
Y		10
Y	GB 2 352 784 A (MOOG INC) 7 February 2001 (2001-02-07) page 1, line 2 - line 17; figure 2	10
X	EP 1 039 165 A (EATON CORP) 27 September 2000 (2000-09-27) column 6, paragraph 28 - column 8, paragraph 35; figure 3	1-3,6,8

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 November 2004	17/11/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	HERNANDEZ, R

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
../GB2004/003023

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 1081405	A	07-03-2001	EP	1081405 A2	07-03-2001
GB 2352784	A	07-02-2001	DE	10036113 A1	15-03-2001
			JP	2001074077 A	23-03-2001
EP 1039165	A	27-09-2000	AU	754865 B2	28-11-2002
			AU	2249000 A	28-09-2000
			BR	0001170 A	16-01-2001
			CN	1267797 A ,B	27-09-2000
			EP	1039165 A2	27-09-2000
			US	6123643 A	26-09-2000