



(11) **EP 3 401 532 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.11.2018 Bulletin 2018/46

(51) Int Cl.:
F02D 9/10 (2006.01) F02D 11/10 (2006.01)

(21) Application number: **17465519.1**

(22) Date of filing: **10.05.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **Continental Automotive GmbH**
30165 Hannover (DE)

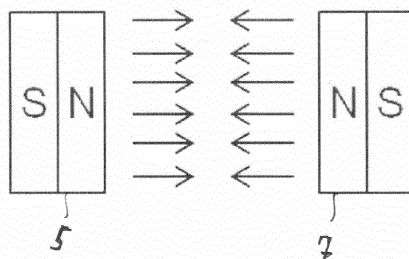
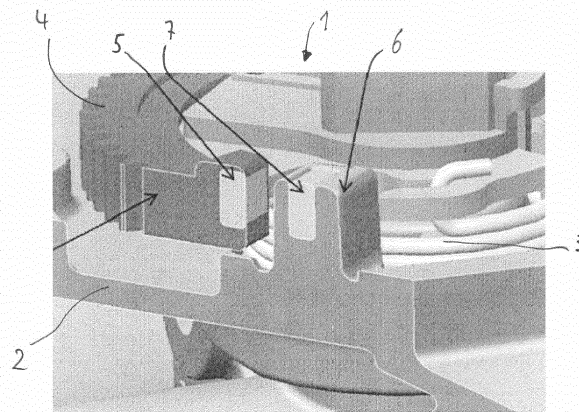
(72) Inventors:
• **Albert, Eusebio-Marius**
300737 Timisoara (RO)
• **Aronet, Vlad**
325300 Bocsa, Caras-Severin (RO)

(54) **VALVE HAVING A THROTTLE FLAP ARRANGED IN A THROTTLE FLAP CONNECTOR**

(57) The invention relates to a valve (1) for regulating a flow cross section in a throttle flap connector, having a throttle flap which is mounted in the throttle flap connector so as to be rotatable about an axis of rotation, wherein the throttle flap is rotatable about the axis of rotation, by means of an actuator which acts on the throttle flap, counter to a force generated by a mechanical spring (3), wherein the maximum angle of rotation of the throttle flap in the throttle flap connector is limited by stops, wherein

the throttle flap, in at least a first position, is fixable in said first position by means of a magnet device (5, 7), wherein the magnet device (5, 7) is formed by a first permanent magnet (5) in the housing (2) of the throttle flap connector, and a second permanent magnet (7) is formed on the throttle flap, wherein the permanent magnets (5, 7) are oriented relative to one another such that those ends of the permanent magnets (5, 7) which are of the same polarity are directed toward one another.

Fig. 1



EP 3 401 532 A1

Description

Technical field

[0001] The invention relates to a valve for regulating a flow cross section in a throttle flap connector, having a throttle flap which is mounted in the throttle flap connector so as to be rotatable about an axis of rotation, wherein the throttle flap is rotatable about the axis of rotation, by means of an actuator which acts on the throttle flap, counter to a force generated by a mechanical spring, wherein the maximum angle of rotation of the throttle flap in the throttle flap connector is limited by stops.

Prior art

[0002] Throttle flaps are used for example in the intake tract of internal combustion engines for the purposes of regulating the air quantity to be supplied to the combustion chamber. Through the use of a throttle flap, it is possible in particular for the supplied air quantity to be adapted to the supplied fuel quantity, and/or for an air-fuel mixture suitable for the respective load state of the internal combustion engine to be generated.

[0003] Throttle flaps in throttle flap connectors are known. DE 195 12 729 A1 describes a throttle flap connector with a tubular housing in which a throttle flap is fastened to a throttle flap shaft which, at its free ends led through recesses in the housing wall, is mounted so as to be rotatable transversely with respect to the longitudinal axis of the tubular housing.

[0004] Throttle flaps can be rotated in their throttle flap connector by means of an actuator, such as for example an electric motor. As a result of the rotation of the throttle flap relative to the throttle flap connector, the flow cross section of the throttle flap connector can be increased and decreased in size. Often, throttle flaps are designed so as to be held open by a mechanical spring when not acted on by the actuator. Here, the actuator is used to close the throttle flap, through the application of a force, counter to the spring force acting on said throttle flap.

[0005] A disadvantage of devices in the prior art is in particular that the positioning of the throttle flap in a defined position, for example in a so-called home position or safety position, in which the throttle flap is open to a minimal extent, is possible only with the aid of mechanical stops or with the aid of active elements such as for example actuators.

Presentation of the invention, problem, solution, advantages

[0006] Therefore, the problem addressed by the present invention is that of creating a throttle flap arranged in a throttle flap connector, which throttle flap serves as a valve for a flow, wherein the throttle flap is fixable in at least one defined position, wherein the fixing is possible in particular even in a deenergized state.

[0007] The problem is solved, with regard to the valve, by means of a valve having the features of claim 1.

[0008] An exemplary embodiment of the invention relates to a valve for regulating a flow cross section in a throttle flap connector, having a throttle flap which is mounted in the throttle flap connector so as to be rotatable about an axis of rotation, wherein the throttle flap is rotatable about the axis of rotation, by means of an actuator which acts on the throttle flap, counter to a force generated by a mechanical spring, wherein the maximum angle of rotation of the throttle flap in the throttle flap connector is limited by stops, wherein the throttle flap, in at least a first position, is fixable in said first position by means of a magnet device, wherein the magnet device is formed by a first permanent magnet in the housing of the throttle flap connector, and a second permanent magnet is formed on the throttle flap, wherein the permanent magnets are oriented relative to one another such that those ends of the permanent magnets which are of the same polarity are directed toward one another.

[0009] The at least first position may vary depending on the construction of the valve and in particular the arrangement and functioning of the mechanical spring and of the actuator. In a first embodiment, the mechanical spring acts on the throttle flap such that the flow cross section of the throttle flap connector is opened up when no force is transmitted from the actuator to the throttle flap. The mechanical spring thus rotates the throttle flap such that the valve is opened. This is advantageous because it is thereby ensured that, even in the event of a failure of the actuator, the throttle flap is opened in order to permit at least emergency operation of a downstream internal combustion engine. In this embodiment, the actuator is used to rotate the throttle flap counter to the mechanical spring such that the flow cross section is decreased in size or is closed entirely.

[0010] In a further embodiment, the operating principle of the mechanical spring and of the actuator may be implemented in reverse fashion, whereby the throttle flap is closed by the mechanical spring and is opened by the actuator counter to the action of the mechanical spring.

[0011] In both embodiments, the magnet device can be used in an effective manner. In the first case, the magnet device prevents the throttle flap from being completely closed by the actuator if the force generated by the magnet device in combination with the mechanical spring is greater than that of the actuator. Also, the magnet device may in this case act as a type of stop damper if the force of the actuator is greater than that of the magnet device.

[0012] In the second case, the magnet device may contribute to a situation in which the throttle flap rotated by the mechanical spring in the direction of a closed position is not fully closed if the force of the magnet device is greater than that of the mechanical spring. Here, the throttle flap is at all times held in a position in which at least a minimal flow cross section of the throttle flap connector remains open. Such a position is known for ex-

ample as a rest position or emergency position, because it ensures a certain minimum functionality of the valve even in the event of failure of the actuator, because at least a minimal flow cross section remains for a passage of flow.

[0013] The magnet device may advantageously also be integrated into the valve so as to act as a stop damper even in the open position of the throttle flap.

[0014] It is particularly advantageous if the throttle flap, in the first position, opens up a defined flow cross section in the throttle flap connector. This is advantageous for ensuring a certain minimum throughput through the valve at all times. In the case of a completely closed throttle flap, it would not be possible for any air mixture to be supplied to the internal combustion engine, whereby operation would be rendered impossible.

[0015] It is also advantageous if the flow cross section of the throttle flap connector can be reduced in size by the throttle flap by means of the mechanical spring counter to the force that can be generated by the actuator, wherein the magnet device prevents a complete closure of the flow cross section of the throttle flap connector. This is advantageous because, in such an embodiment, the magnet device ensures that the throttle flap cannot be rotated into a fully closed position.

[0016] A preferred exemplary embodiment is characterized in that at least one of the permanent magnets is surrounded by means for directing the magnetic field, wherein said means are formed by metal plates which at least partially enclose the permanent magnets. Such means for directing the magnetic field are advantageous because, by means of these, the action of the respective permanent magnets can be improved. As a result of the directing of the magnetic field, the force of the permanent magnets can be considerably increased, whereby, with an unchanged magnet size, greater forces can be generated, or alternatively, smaller permanent magnets can be used.

[0017] It is also preferable if the means for directing the magnetic field are formed by steel plates. Steel plates are, owing to their material characteristics, particularly well-suited for directing magnetic field lines.

[0018] It is furthermore advantageous if the second permanent magnet arranged on the throttle flap is movable on a circular path formed around the axis of rotation of the throttle flap, wherein the spacing between the first permanent magnet and the second permanent magnet in a circumferential direction along the circular path is defined by the angle of rotation of the throttle flap relative to the throttle flap connector. This is advantageous for ensuring that the permanent magnets are moved toward one another or away from one another as a result of the rotation of the throttle flap, whereby the function of said permanent magnets is ensured.

[0019] It is furthermore advantageous if the second permanent magnet is part of the toothed ring by means of which the movement of the actuator can be transmitted to the throttle flap. This is advantageous because the

movement of the throttle flap thus leads directly to a movement of the permanent magnet.

[0020] It is also expedient if the throttle flap is rotatable between two maximum positions, wherein, in the first maximum position, the throttle flap closes the flow cross section of the throttle flap connector, and in the second maximum position, the throttle flap opens up the flow cross section of the throttle flap connector. The throttle flap is advantageously designed such that complete closure of the throttle flap is prevented in order that a minimum functionality of the valve is maintained even in the event of a defect, for example in the event of failure of the actuator.

[0021] It is also advantageous if the throttle flap, in the first position in which it is fixable by means of the magnet device, incompletely closes the flow cross section of the throttle flap connector and holds a minimum flow cross section open. This is advantageous for ensuring that, even in the event of a defect, a minimum quantity of air can pass into the combustion chamber of the downstream internal combustion engine and thus ensure at least emergency operation. This applies in particular to an embodiment of the valve in which the mechanical spring would lead to complete closure of the throttle flap in the event of failure of the actuator.

[0022] It is furthermore expedient if the force generated by the magnet device for holding the throttle flap in the first position is at least equal to or greater than the force generated by the mechanical spring. This is advantageous for ensuring that the throttle flap would not be pushed into a fully closed position counter to the magnetic forces.

[0023] It is furthermore advantageous if the two permanent magnets are arranged on a common circular path, wherein the first permanent magnet is connected positionally fixedly to the housing of the throttle flap connector, and the second permanent magnet is rotatable with the throttle flap along the circular path. In this way, it is ensured that the magnets are moved toward one another or away from one another in controlled fashion as a result of the rotation of the throttle flap.

[0024] It is also preferable if the force generated by the magnet device between the permanent magnets of the throttle flap and of the throttle flap connector counteract the force generated by the actuator. This is advantageous if the valve is designed such that the mechanical spring opens the throttle flap and the actuator acts counter to this. The actuator thus closes the throttle flap as far as a point at which the closing force of the actuator is equal to the repelling forces between the two permanent magnets.

[0025] Advantageous refinements of the present invention are described in the subclaims and in the following description of the figures.

Brief description of the drawings

[0026] Below, the invention will be discussed in detail

on the basis of an exemplary embodiment and with reference to the drawing, in which:

figure 1 shows a perspective view of a detail of the valve according to the invention, wherein the upper part of the figure shows the two permanent magnets, and the lower part of the figure is a schematic illustration of the magnetic field generated by the permanent magnets.

Preferred embodiment of the invention

[0027] Figure 1 shows, in the upper part, a detail view of the valve 1, wherein the illustration shows substantially the housing 2 of the throttle flap connector, the mechanical spring 3 and the toothed ring section 4 which transmits the movement of the actuator (not shown) to the throttle flap (likewise not shown).

[0028] A permanent magnet 5 is arranged at the free end region of the toothed ring section 4. A further permanent magnet 7 is arranged in a receptacle 6 of the housing 2.

[0029] The two permanent magnets 5 and 7 are oriented relative to one another such that in each case the identical magnetic poles point toward one another. This has the effect that the two permanent magnets 5 and 7 repel one another when they are moved close enough to one another.

[0030] The toothed ring section 4 is rotated by an actuator in order to move the throttle flap that is attached to the toothed ring section 4. Here, the throttle flap and the toothed ring section 4 preferably rotate about a common axis of rotation. The permanent magnet 5 thus moves on a circular path defined by the toothed ring section 4. The second permanent magnet 7 is preferably likewise arranged on said circular path in order to ensure that the two permanent magnets 5, 7 can be moved toward one another or away from one another as a result of the rotation of the throttle flap.

[0031] If the two permanent magnets 5, 7 have been moved close enough to one another, they repel one another owing to the orientation of the permanent magnets 5, 7, and thus generate a spacing between themselves. The toothed ring section 4 and thus the attached throttle flap are thereby fixed in a position.

[0032] Depending on the construction of the valve and in particular on the direction of action of the mechanical spring 3 and of the force imparted by the actuator, it is thus possible for the throttle flap to be fixed in a slightly open position or in a fully open position.

[0033] The force generated by the repulsion of the permanent magnets 5, 7 may be used both for opening the throttle flap and for closing the latter. This is dependent substantially on the directions of action of the actuator and of the mechanical spring 3.

[0034] The magnet device 5, 7 may also be used as a stop damper if the force component that moves the toothed ring section in the direction of the second per-

manent magnet 7 is correspondingly dimensioned so as to overcome the repulsion force. In such a situation, the toothed ring section 4 is braked by the repulsion force and is moved as far as a physical stop by the relatively high actuation force counter to the repulsion action.

[0035] If the repulsion force is greater than the actuation force that the toothed ring section 4 imparts to the second permanent magnet 7, the movement of the toothed ring section 4 is ended, possibly with slight overshoots, before the toothed ring section 4 abuts against the housing 1.

[0036] Depending on the manner in which the individual force components of the mechanical spring 3, of the actuator and of the magnetic repulsion are directed and thus act on the throttle flap, corresponding functionality can be realized. Here, the common functionalities include stop damping and fixing in a defined position, in which the throttle flap is at least slightly open.

[0037] The lower part of figure 1 shows a diagrammatic sketch of two permanent magnets, showing the arrangement of the equal magnetic poles toward one another. The permanent magnets 5, 7 in the upper part of figure 1 are arranged in the same manner as in the diagrammatic sketch.

[0038] The exemplary embodiment of figure 1 is in particular not of a restrictive nature, and serves for illustrating the concept of the invention.

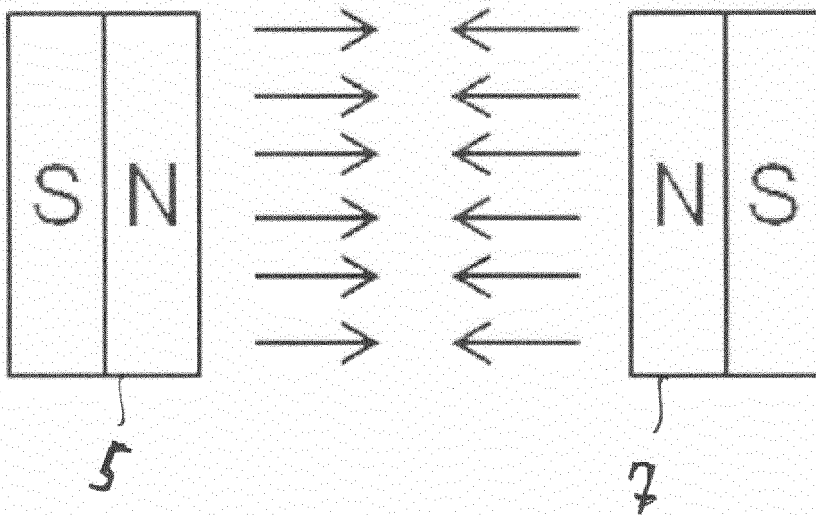
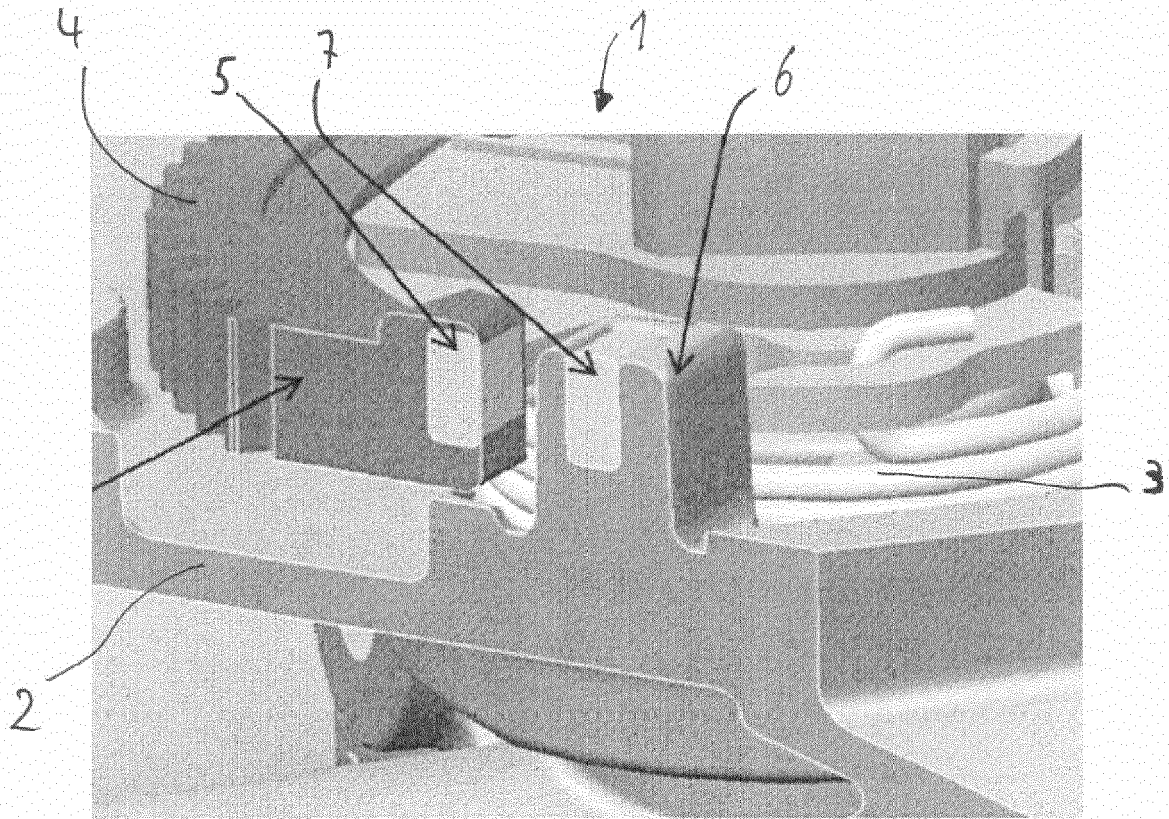
30 Claims

1. A valve (1) for regulating a flow cross section in a throttle flap connector, having a throttle flap which is mounted in the throttle flap connector so as to be rotatable about an axis of rotation, wherein the throttle flap is rotatable about the axis of rotation, by means of an actuator which acts on the throttle flap, counter to a force generated by a mechanical spring (3), wherein the maximum angle of rotation of the throttle flap in the throttle flap connector is limited by stops, **characterized in that** the throttle flap, in at least a first position, is fixable in said first position by means of a magnet device (5, 7), wherein the magnet device (5, 7) is formed by a first permanent magnet (5) in the housing (2) of the throttle flap connector, and a second permanent magnet (7) is formed on the throttle flap, wherein the permanent magnets (5, 7) are oriented relative to one another such that those ends of the permanent magnets (5, 7) which are of the same polarity are directed toward one another.
2. The valve (1) as claimed in claim 1, **characterized in that** the throttle flap, in the first position, opens up a defined flow cross section in the throttle flap connector.
3. The valve (1) as claimed in one of the preceding claims, **characterized in that** the flow cross section

of the throttle flap connector can be reduced in size by the throttle flap by means of the mechanical spring (3) counter to the force that can be generated by the actuator, wherein the magnet device (5, 7) prevents a complete closure of the flow cross section of the throttle flap connector.

4. The valve (1) as claimed in one of the preceding claims, **characterized in that** at least one of the permanent magnets (5, 7) is surrounded by means for directing the magnetic field, wherein said means are formed by metal plates which at least partially enclose the permanent magnets (5, 7). 5
10
5. The valve (1) as claimed in claim 4, **characterized in that** the means for directing the magnetic field are formed by steel plates. 15
6. The valve (1) as claimed in one of the preceding claims, **characterized in that** the second permanent magnet (7) arranged on the throttle flap is movable on a circular path formed around the axis of rotation of the throttle flap, wherein the spacing between the first permanent magnet (5) and the second permanent magnet (7) in a circumferential direction along the circular path is defined by the angle of rotation of the throttle flap relative to the throttle flap connector. 20
25
7. The valve (1) as claimed in one of the preceding claims, **characterized in that** the second permanent magnet (7) is part of the toothed ring (4) by means of which the movement of the actuator can be transmitted to the throttle flap. 30
35
8. The valve (1) as claimed in one of the preceding claims, **characterized in that** the throttle flap, in the first position in which it is fixable by means of the magnet device (5, 7), incompletely closes the flow cross section of the throttle flap connector and holds a minimum flow cross section open. 40
9. The valve (1) as claimed in one of the preceding claims, **characterized in that** the force generated by the magnet device (5, 7) for holding the throttle flap in the first position is at least equal to or greater than the force generated by the mechanical spring (3). 45
10. The valve (1) as claimed in one of the preceding claims, **characterized in that** the two permanent magnets (5, 7) are arranged on a common circular path, wherein the first permanent magnet (5) is connected positionally fixedly to the housing (3) of the throttle flap connector, and the second permanent magnet (7) is rotatable with the throttle flap along the circular path. 50
55
11. The valve (1) as claimed in one of the preceding claims, **characterized in that** the force generated by the magnet device (5, 7) between the permanent magnets (5, 7) of the throttle flap and of the throttle flap connector counteract the force generated by the actuator.

Fig. 1





EUROPEAN SEARCH REPORT

Application Number
EP 17 46 5519

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 6 779 775 B2 (A B ELEKTRONIK GMBH [DE]) 24 August 2004 (2004-08-24) * column 3, line 64 - column 6, line 7; figures 1-7 *	1-11	INV. F02D9/10 F02D11/10
Y	DE 101 43 835 A1 (PIERBURG GMBH [DE]) 27 March 2003 (2003-03-27) * paragraph [0009] - paragraph [0013]; figures 1-2 *	1-11	
Y	GB 2 232 274 A (PEI QUI MAO [CN]; JING GAN; BING HUANG QUE) 5 December 1990 (1990-12-05) * page 3, line 7 - page 6, line 8; figures 1-3 *	1-11	
Y	JP H10 160027 A (NISSAN MOTOR) 16 June 1998 (1998-06-16) * paragraph [0005] - paragraph [0015]; figures 1-7 *	1-11	
Y	US 5 092 296 A (GUENTER SPIEGEL [DE] ET AL) 3 March 1992 (1992-03-03) * column 2, line 11 - column 5, line 20; figures 1-2 *	1-11	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) F02D
Place of search The Hague		Date of completion of the search 29 November 2017	Examiner Raposo, Jorge
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			

EPO FORM 1503 03/02 (P04C01)

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

EP 17 46 5519

5

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-11-2017

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6779775	B2 24-08-2004	DE 10235049 A1	19-02-2004
		EP 1387064 A2	04-02-2004
		US 2004021106 A1	05-02-2004

DE 10143835	A1 27-03-2003	NONE	

GB 2232274	A 05-12-1990	CN 1037381 A	22-11-1989
		DE 3936992 A1	06-12-1990
		GB 2232274 A	05-12-1990
		JP H039182 A	17-01-1991
		US 5009388 A	23-04-1991

JP H10160027	A 16-06-1998	NONE	

US 5092296	A 03-03-1992	DE 4022825 A1	28-02-1991
		EP 0439577 A1	07-08-1991
		JP H04501300 A	05-03-1992
		US 5092296 A	03-03-1992
		WO 9102891 A1	07-03-1991

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 19512729 A1 [0003]