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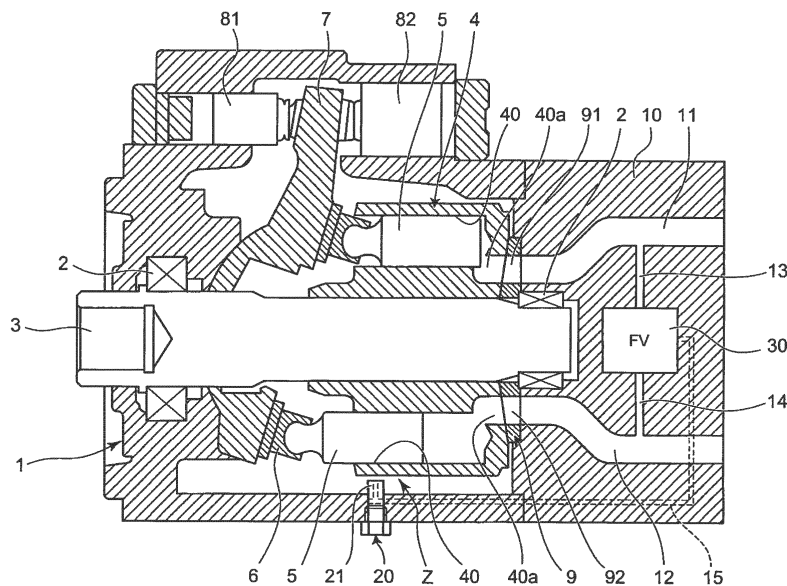
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(54) **AXIAL PISTON MOTOR**

(57) On an inner surface of a housing 1, a nozzle 21 for jetting operation oil is provided at a position opposite to an outer circumferential surface of a cylinder block 4. With this configuration, by spraying the operation oil from the nozzle 21 to the outer circumferential surface of the

cylinder block 4 during rotation of the cylinder block 4, this operation oil can remove frictional heat generated by sliding between a piston 5 and a cylinder 40, and seizure of the piston 5 and seizure of the cylinder 40 can be prevented.

*Fig 1*



**Description**

## TECHNICAL FIELD

**[0001]** The present invention relates to an axial piston motor.

## BACKGROUND ART

**[0002]** Conventionally, there has been an axial piston motor described in Japanese Patent No. 4828371 (Patent Document 1). As illustrated in Fig. 6, this axial piston motor includes a housing 100, a drive shaft 101 mounted to the housing 100 so as to be freely rotatable, a cylinder block 102 fixed to the drive shaft 101, a piston 103 fitted into a cylinder 102a of the cylinder block 102 so as to be capable of freely advancing and retreating, and a wash plate 104 supporting the piston 103 through a shoe 105. The piston is reciprocally moved by supplying operation oil to the cylinder 102a. Then, the cylinder block 102 and the drive shaft 101 are rotated by reciprocally moving the piston 103.

**[0003]** Incidentally, when the piston 103 is reciprocally moved, heat caused by friction with the piston 103 is generated on an inner surface of the cylinder 102a. A heating value thereof depends on a contact pressure between the cylinder 102a and the piston 103.

**[0004]** In a conventional low speed rotation specification, since centrifugal force (illustrated by arrows) acted on the piston 103 and the shoe 105 is small, the contact pressure is small and the heating value is also small. Accordingly, only by securing a small clearance between the cylinder 102a and the piston 103 for causing the operation oil to flow, the inner surface of the cylinder 102a can be sufficiently cooled by the operation oil escaped into the clearance.

**[0005]** Currently, in construction machinery or industrial machinery, because of weight reduction and space saving of a driving device, higher pressure and higher speed thereof are in progress. As a result, it is desirable that a hydraulic device can be used at high speed rotation.

**[0006]** In a case where the cylinder block 102 is rotated at a high speed, the centrifugal force (illustrated by the arrows) affects the contact pressure, and the heating value generated on the inner surface of the cylinder 102a becomes large. Accordingly, the operation oil escaped into the clearance cannot sufficiently cool the inner surface of the cylinder 102a. Further, as the centrifugal force increases, the piston 103 is pressed outward in a radial direction, and a width of the clearance on an outer side of the piston 103 in the radial direction is narrowed.

**[0007]** As a result, an amount of operation oil passing through the outer side of the piston 103 in the radial direction is reduced, and seizure of at least one of the piston 103 and the cylinder 102a is generated. On the other hand, when the clearance is widened to secure the amount of operation oil passing through the outer side

of the piston 103 in the radial direction, an amount of operation oil leaked from the cylinder 102a increases, which deteriorates the performance of the device.

5 PRIOR ART DOCUMENT

PATENT DOCUMENT

**[0008]** Patent Document 1: Japanese Patent No. 10 4828371

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

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**[0009]** Accordingly, an object of the present invention is to provide an axial piston motor which is capable of preventing seizure of a piston and seizure of a cylinder and operating a cylinder block at high speed rotation and which is capable of preventing deterioration of performance due to an increase in an amount of operation oil leaked from the cylinder.

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SOLUTIONS TO THE PROBLEMS

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**[0010]** In order to accomplish the above object, there is provided, an axial piston motor comprising:

a housing;

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a drive shaft which is mounted to the housing so as to be freely rotatable;

a cylinder block which is fixed to the drive shaft and has a plurality of cylinders arrayed in a circumferential direction;

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a plurality of pistons which is fitted into the plurality of cylinders so as to be capable of freely advancing and retreating; and

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a swash plate which supports the plurality of pistons by a tiltable surface relative to the drive shaft, where-

in on an inner surface of the housing, a nozzle for jetting operation oil is provided at a position opposite to an outer circumferential surface of the cylinder block.

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**[0011]** According to the axial piston motor of this invention, on the inner surface of the housing, the nozzle for jetting operation oil is provided at the position opposite to the outer circumferential surface of the cylinder block. With this configuration, by spraying the operation oil from the nozzle to the outer circumferential surface of the cylinder block during rotation of the cylinder block, this operation oil can remove frictional heat generated by sliding between the piston and the cylinder, and seizure of the piston and seizure of the cylinder can be prevented.

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**[0012]** Therefore, since the seizure of the piston and the seizure of the cylinder can be prevented, the cylinder block can be operated at high speed rotation. Further, since the seizure of the piston and the seizure of the

cylinder can be prevented without increasing a clearance between the piston and the cylinder, deterioration of performance due to an increase in an amount of the operation oil leaked from the cylinder can be prevented.

**[0013]** In the axial piston motor of one embodiment, the outer circumferential surface of the cylinder block has a high temperature zone which has a temperature higher than a predetermined threshold value during rotation of the cylinder block, and the nozzle is opposed to the high temperature zone of the cylinder block.

**[0014]** Here, the threshold value is a value in which seizure of at least one of the piston and the cylinder can occur between during the rotation of the cylinder block.

**[0015]** According to the axial piston motor of this embodiment, since the nozzle is opposed to the high temperature zone of the cylinder block, the operation oil can be sprayed from the nozzle to the high temperature zone, and the seizure of the piston and the seizure of the cylinder can be reliably prevented.

**[0016]** In the axial piston motor of one embodiment, as viewed in an axial direction of the drive shaft, the high temperature zone of the cylinder block is in a set range where a center angle is from +40° to -40° when a bottom dead center of the piston is selected as a standard.

**[0017]** Here, a positive direction of the center angle is a rotation direction of the cylinder block.

**[0018]** According to the axial piston motor of this embodiment, though the high temperature zone becomes a zone where seizure can occur the most, the high temperature zone is in the set range. Therefore, the seizure can be reliably prevented by the jetting of the operation oil from the nozzle.

**[0019]** In the axial piston motor of one embodiment, as viewed in the axial direction of the drive shaft, the nozzle is disposed outside the position at which the piston is at the bottom dead center in a radial direction, and as viewed in the axial direction of the drive shaft, a jetting direction of the nozzle intersects the set range of the cylinder block.

**[0020]** According to the axial piston motor of this embodiment, since the nozzle is disposed outside the position where the piston is at the bottom dead center in the radial direction, and the jetting direction of the nozzle intersects the set range of the cylinder block, the nozzle can be disposed at the appropriate position.

**[0021]** In the axial piston motor of one embodiment, the axial piston motor further comprises a plug screwed to the housing in a penetrated state, wherein the plug has the nozzle.

**[0022]** According to the axial piston motor of this embodiment, since the plug is screwed to the housing and the plug has the nozzle, the attachment and removal of the nozzle to and from the housing can be easily performed by attaching and removing the plug to and from the housing.

**[0023]** In the axial piston motor of one embodiment,

the housing has a pair of main passages, which is connected to the cylinder and supplies and discharges the operation oil to the cylinder and

a flushing valve, which is switched by pressure difference between the pair of main passages and guides the operation oil passing through the main passage on a low pressure side to the nozzle, is provided at the housing.

**[0024]** According to the axial piston motor of this embodiment, since the flushing valve is provided at the housing, the motor can be made compact.

## EFFECTS OF THE INVENTION

**[0025]** According to the axial piston motor of this invention, on the inner surface of the housing, the nozzle for jetting operation oil is provided at the position opposite to the outer circumferential surface of the cylinder block. With this configuration, the seizure of the piston and the seizure of the cylinder can be prevented, the cylinder block can be operated at high speed rotation, and deterioration of performance due to the increase in the amount of the operation oil leaked from the cylinder can be prevented.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0026]

Fig. 1 is a sectional view illustrating an axial piston motor of one embodiment of the present invention.

Fig. 2 is a sectional view of the motor orthogonal to an axis of a drive shaft.

Fig. 3 is a circuit diagram of the motor.

Fig. 4 is a sectional view of a flushing valve.

Fig. 5 is a sectional view illustrating a motor of another embodiment.

Fig. 6 is a sectional view illustrating a conventional axial piston motor.

## EMBODIMENTS OF THE INVENTION

**[0027]** Hereinafter, this invention will be described in detail by way of embodiments thereof illustrated in the accompanying drawings.

**[0028]** Fig. 1 is sectional view illustrating an axial piston motor of one embodiment of this invention. As illustrated in Fig. 1, this motor includes a housing 1, a drive shaft 3 mounted to this housing 1 through a bearing 2 so as to be freely rotatable, and a cylinder block 4 fixed to this drive shaft 3.

**[0029]** The cylinder block 4 has a plurality of cylinders 40 arrayed in a circumferential direction. A plurality of pistons 5 is fitted into this plurality of cylinders 40 so as to be capable of freely advancing and retreating.

**[0030]** A tip part of the piston 5 is formed in a spherical shape and coupled to a shoe 6. This shoe 6 is supported by a swash plate 7 positioned relatively to the housing 1. This swash plate 7 has a tiltable surface relative to the

drive shaft 3, and supports the plurality of pistons 5 by the tilted surface. A tilting angle of this swash plate 7 relative to the drive shaft 3 is adjusted by a first control piston 81 and a second control piston 82.

**[0031]** The housing 1 has a cover 10 covering an end part side of the drive shaft 3. A first main passage 11 and a second main passage 12, which are connected to the cylinder 40 and supply and discharge operation oil to the cylinder 40, are provided at this cover 10.

**[0032]** A valve plate 9 is mounted on an end surface of the cover 10 on the cylinder block 4 side. This valve plate 9 has an arc-shaped first port 91 and an arc-shaped second port 92, and the first port 91 and the second port 92 are formed symmetrically.

**[0033]** A port 40a for supplying and discharging the operation oil to an inside of the cylinder 40 is formed at a bottom part of each cylinder 40. An end surface of the cylinder block 4 is in contact with the valve plate 9.

**[0034]** The first main passage 11 of the cover 10, the first port 91 of the valve plate 9, and the port 40a of the predetermined cylinder 40 communicate with one another. The second main passage 12 of the cover 10, the second port 92 of the valve plate 9, and the port 40a of the predetermined cylinder 40 communicate with one another.

**[0035]** Then, when the operation oil is supplied from the first main passage 11, the operation oil flows into the predetermined cylinder 40 via the first port 91. As a result, the piston 5 reciprocates, and in this moving of piston 5 reciprocally, the cylinder block 4 and the drive shaft 3 are rotated in one direction. After that, the operation oil within the cylinder 40 is discharged from the second main passage 12 via the second port 92. A pressure within the first main passage 11 on a supply side is higher than a pressure within the second main passage 12 on a discharge side.

**[0036]** On the other hand, when the operation oil is supplied from the second main passage 12, the cylinder block 4 and the drive shaft 3 are rotated in another direction. After that, the operation oil within the cylinder 40 is discharged from the first main passage 11.

**[0037]** A nozzle 21 for jetting the operation oil is arranged on an inner surface of the housing 1 and is provided at a position opposite to an outer circumferential surface of the cylinder block 4. This nozzle 21 is provided at a tip part of a plug 20. This plug 20 is screwed to the housing 1 in a penetrated state.

**[0038]** The nozzle 21 faces a nozzle passage 15 provided at the housing 1, and the nozzle passage 15 is connected to a flushing valve 30 provided at the cover 10 of the housing 1. This flushing valve 30 is connected to a first sub-passage 13 communicated with the first main passage 11 and is connected to a second sub-passage 14 communicated with the second main passage 12. This flushing valve 30 is switched by pressure difference between the first main passage 11 and the second main passage 12, and the operation oil passing through the main passage on a low pressure side is guided to the

nozzle 21 via the nozzle passage 15.

**[0039]** As illustrated in Figs. 1 and 2, an outer circumferential surface of the cylinder block 4 has a high temperature zone Z where a temperature can be higher than a predetermined threshold value during rotation of the cylinder block 4. The threshold value is a value in which seizure of at least one of the piston 5 and the cylinder 40 can occur between during the rotation of the cylinder block 4.

**[0040]** As viewed in an axial direction of the drive shaft 3, the high temperature zone Z of the cylinder block 4 is in a set range R where a center angle is from  $+40^\circ$  to  $-40^\circ$  when a position L, at which the piston 5 is at a bottom dead center, is selected as a standard. Here, a positive direction of the center angle is a rotation direction of the cylinder block 4. The bottom dead center of the piston 5 is a position where the piston 5 is protruded the most from the cylinder 40.

**[0041]** Most specifically, a line connecting a center of the piston 5 and a center of the drive shaft 3, which represents the bottom dead center, is selected as a standard line B, the set range R is a range where the center angle is from  $+40^\circ$  to  $-40^\circ$  around the standard line B.

**[0042]** The nozzle 21 is opposed to the high temperature zone Z of the cylinder block 4. Specifically speaking, as viewed in the axial direction of the drive shaft 3, the nozzle 21 is disposed outside the position L at which the piston 5 is at the bottom dead center in a radial direction. As viewed in the axial direction of the drive shaft 3, a jetting direction of the nozzle 21 intersects the set range R of the cylinder block 4. As viewed in the axial direction of the drive shaft 3, the jetting direction of the nozzle 21 coincides with a radial direction of the cylinder block 4 (the standard line B).

**[0043]** Fig. 3 illustrates a circuit diagram of the motor. As illustrated in Fig. 3, the first main passage 11 and the second main passage 12 are connected to a motor unit 50 including the drive shaft 3, the cylinder block 4, the piston 5, and the swash plate 7. The first sub-passage 13 branched from the first main passage 11 is connected to a first port P1 of a spool 31 of the flushing valve 30, and the second sub-passage 14 branched from the second main passage 12 is connected to a second port P2 of the spool 31. The nozzle passage 15 faced by the nozzle 21 is connected to a third port P3 of the spool 31.

**[0044]** The spool 31 can be situated at a first position S1, a second position S2, and a third position S3. The first position S1 is a neutral position, and the first port P1 and the second port P2 are not connected to the third port P3 in the neutral position. At the second position S2, the second port P2 is connected to the third port P3. At the third position S3, the first port P1 is connected to the third port P3.

**[0045]** Then, in a case where high pressure operation oil is supplied to the first main passage 11 and low pressure operation oil is discharged from the second main passage 12, the spool 31 is switched from the first position S1 to the second position S2 by a differential pres-

sure between the high pressure operation oil in the first sub-passage 13 and the low pressure operation oil in the second sub-passage 14, and the second sub-passage 14 communicates with the nozzle passage 15. With this configuration, the low pressure operation oil in the second sub-passage 14 can be jetted from the nozzle 21 to the motor unit 50.

**[0046]** On the other hand, in a case where high pressure operation oil is supplied to the second main passage 12 and low pressure operation oil is discharged from the first main passage 11, the spool 31 is switched from the first position S1 to the third position S3 by a differential pressure between the high pressure operation oil in the second sub-passage 14 and the low pressure operation oil in the first sub-passage 13, and the first sub-passage 13 communicates with the nozzle passage 15. With this configuration, the low pressure operation oil in the first sub-passage 13 can be jetted from the nozzle 21 to the motor unit 50.

**[0047]** The first and second control pistons 81, 82 (illustrated in Fig. 1) may be driven by branching passages from the first sub-passage 13 and the second sub-passage 14 and flowing the operation oil into these pistons 81, 82 through the branch passages.

**[0048]** Fig. 4 is a sectional view of the flushing valve 30. As illustrated in Fig. 4, the spool 31 is fitted into a valve hole 32 provided at the cover 10 of the housing 1 so as to be freely slidable. Then, as illustrated by a solid arrow, when the high pressure operation oil is supplied to the first sub-passage 13, the spool 31 receives this high pressure operation oil and is moved to a right side in the drawing (the second position S2 in Fig. 3). As illustrated in dotted arrows, the low pressure operation oil is supplied from the second sub-passage 14 to the nozzle passage 15.

**[0049]** In the above-structured axial piston 5 motor, on the inner surface of the housing 1, the nozzle 21 for jetting operation oil is provided at the position opposite to the outer circumferential surface of the cylinder block 4. With this configuration, by spraying the operation oil from the nozzle 21 to the outer circumferential surface of the cylinder block 4 during the rotation of the cylinder block 4, this operation oil can remove frictional heat generated by the sliding between the piston 5 and the cylinder 40, and seizure of the piston 5 and seizure of the cylinder 40 can be prevented.

**[0050]** Therefore, since the seizure of the piston 5 and the seizure of the cylinder 40 can be prevented, the cylinder block 4 can be operated at high speed rotation. Further, since the seizure of the piston 5 and the seizure of the cylinder 40 can be prevented without increasing a clearance between the piston 5 and the cylinder 40, deterioration of performance due to an increase in an amount of the operation oil leaked from the cylinder 40 can be prevented.

**[0051]** Further, since the nozzle 21 is opposed to the high temperature zone Z of the cylinder block 4, the operation oil can be sprayed from the nozzle 21 to the high

temperature zone Z, and the seizure of the piston 5 and the seizure of the cylinder 40 can be reliably prevented.

**[0052]** Further, though the high temperature zone Z becomes a zone where seizure can occur the most, the high temperature zone Z is in the set range R. Accordingly, the seizure can be reliably prevented by the jetting of the operation oil from the nozzle 21.

**[0053]** Further, the nozzle 21 is disposed outside in the radial direction of the position L at which the piston 5 is at the bottom dead center, and the jetting direction of the nozzle 21 intersects the set range R of the cylinder block 4. Accordingly, the nozzle 21 is disposed at the appropriate position.

**[0054]** Further, the plug 20 is screwed to the housing 1, and the plug 20 has the nozzle 21. Accordingly, the attachment and removal of the nozzle 21 to and from the housing 1 can be easily performed by attaching and removing the plug 20 to and from the housing 1.

**[0055]** Further, since the flushing valve 30 is provided at the housing 1, the motor can be made compact.

**[0056]** It should be noted that this invention is not limited to the aforementioned embodiment. The numbers of the piston 5 and the cylinder 40 may be increased and decreased. The number of the nozzle 21 may be increased and decreased.

**[0057]** Further, in the above-described embodiment, the set range R of the cylinder block 4 is a range where the center angle is from  $+40^\circ$  to  $-40^\circ$  around the standard line B. However, the set range R may be a range where the center angle is from  $+15^\circ$  to  $-15^\circ$  around the standard line B. With this configuration, the operation oil can be sprayed at pinpoint from the nozzle 21 to an area of the cylinder block 4 where it is highly possible that the seizure occurs.

**[0058]** Further, in the above-described embodiment, as viewed in the axial direction of the drive shaft 3, the jetting direction of the nozzle 21 coincides with the radial direction of the cylinder block 4. However, as long as the jetting direction of the nozzle 21 intersects the set range R, the jetting direction may be tilted in the radial direction of the cylinder block 4. Needless to say, a specific numerical value of the set range R is not limited to this embodiment, and designs can be modified.

**[0059]** Further, in the above-described embodiment, on the plane surface including the nozzle 21 and the axis of the drive shaft 3, the jetting direction of the nozzle 21 coincides with the direction (the radial direction) orthogonal to the axis of the drive shaft 3. However, as illustrated in Fig. 5, a jetting direction of a nozzle 21 may be tilted in a range  $\theta$  of from  $+45^\circ$  to  $-45^\circ$  when a direction S orthogonal to an axis of a drive shaft 3 is selected as a standard.

**[0060]** Further, in the above-described embodiment, the nozzle 21 is a part of the plug 20. However, the nozzle 21 may be directly formed at the housing 1.

**[0061]** In the above-described embodiment, the nozzle may be opposed to a zone other than the high temperature zone. The high temperature zone may be a range

other than the range where the center angle is from +40° to -40°. The nozzle may be disposed outside a position other than the position where the piston is at the bottom dead center in the radial direction. The nozzle may be provided at a part other than the plug. The flushing valve may be omitted.

#### DESCRIPTION OF REFERENCE SIGNS

##### [0062]

1:	Housing
3:	Drive shaft
4:	Cylinder block
5:	Piston
7:	Swash plate
9:	Valve plate
10:	Cover
11:	First main passage
12:	Second main passage
13:	First sub-passage
14:	Second sub-passage
15:	Nozzle passage
20:	Plug
21:	Nozzle
30:	Flushing valve
31:	Spool
40:	Cylinder
40a:	Port
B:	Standard line
L:	Position where piston is at bottom dead center
R:	Set range
Z:	High temperature zone

#### Claims

##### 1. An axial piston motor comprising:

a housing; 40  
 a drive shaft which is mounted to the housing so as to be freely rotatable;  
 a cylinder block which is fixed to the drive shaft and has a plurality of cylinders arrayed in a circumferential direction; 45  
 a plurality of pistons which is fitted into the plurality of cylinders so as to be capable of freely advancing and retreating; and  
 a swash plate which supports the plurality of pistons by a tiltable surface relative to the drive shaft, wherein 50  
 on an inner surface of the housing, a nozzle for jetting operation oil is provided at a position opposite to an outer circumferential surface of the cylinder block. 55

##### 2. The axial piston motor according to claim 1, wherein the outer circumferential surface of the cylinder block

has a high temperature zone which has a temperature higher than a predetermined threshold value during rotation of the cylinder block, and the nozzle is opposed to the high temperature zone of the cylinder block.

3. The axial piston motor according to claim 2, wherein as viewed in an axial direction of the drive shaft, the high temperature zone of the cylinder block is in a set range where a center angle is from +40° to -40° when a bottom dead center of the piston is selected as a standard. 10

4. The axial piston motor according to claim 3, wherein as viewed in the axial direction of the drive shaft, the nozzle is disposed outside the position at which the piston is at the bottom dead center in a radial direction, and as viewed in the axial direction of the drive shaft, a jetting direction of the nozzle intersects the set range of the cylinder block. 20

5. The axial piston motor according to any one of claims 1 to 4, further comprising a plug screwed to the housing in a penetrated state, wherein the plug has the nozzle. 25

6. The axial piston motor according to any one of claims 1 to 5, wherein the housing has a pair of main passages, which is connected to the cylinder and supplies and discharges the operation oil to the cylinder and a flushing valve, which is switched by pressure difference between the pair of main passages and guides the operation oil passing through the main passage on a low pressure side to the nozzle, is provided at the housing. 30 35

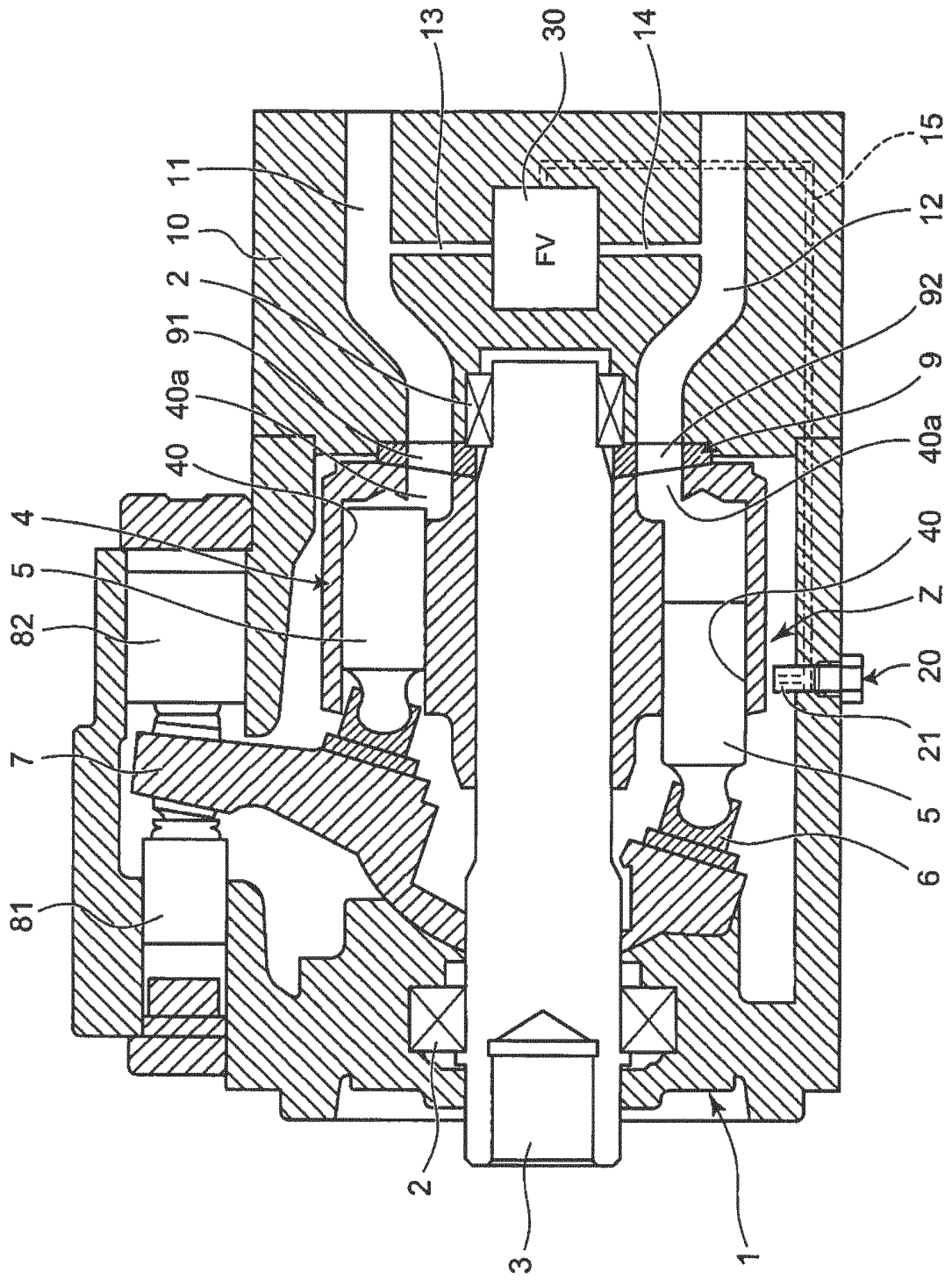


Fig 1

Fig 2

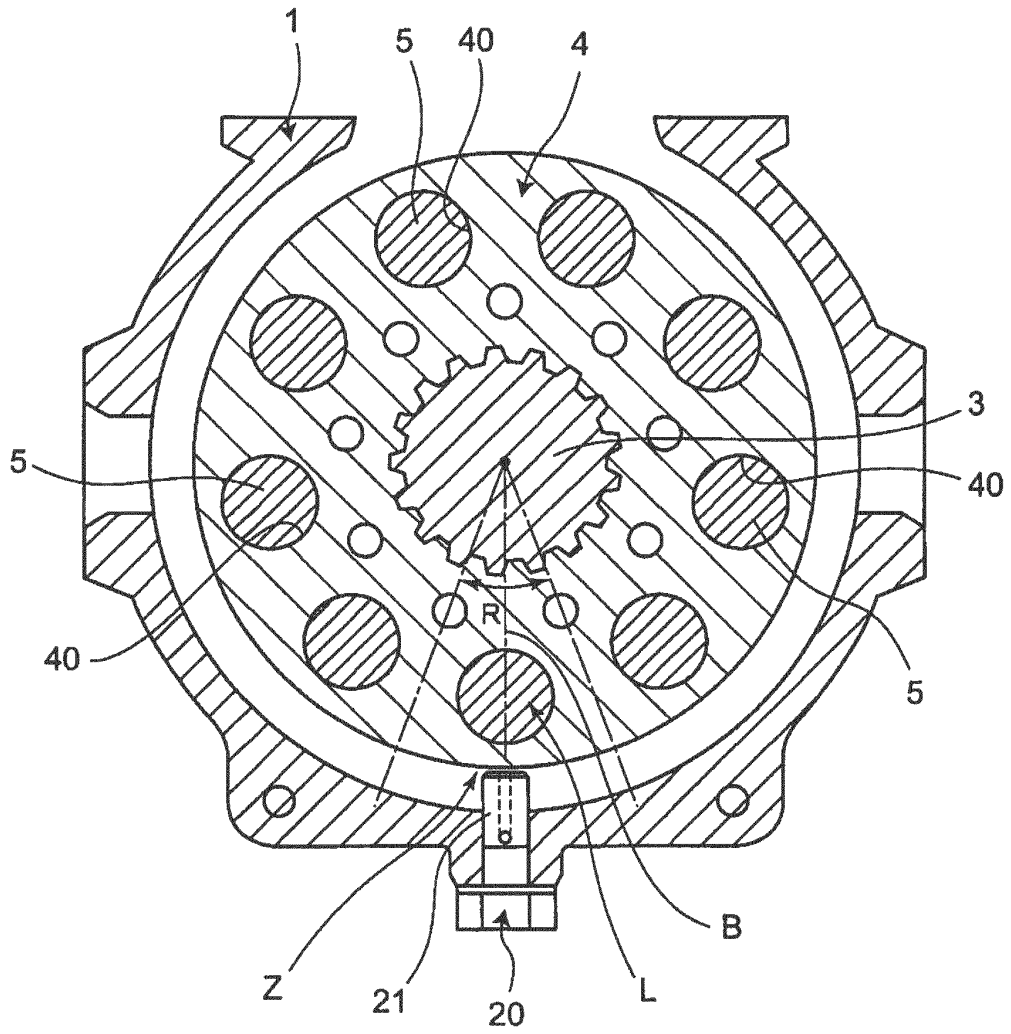
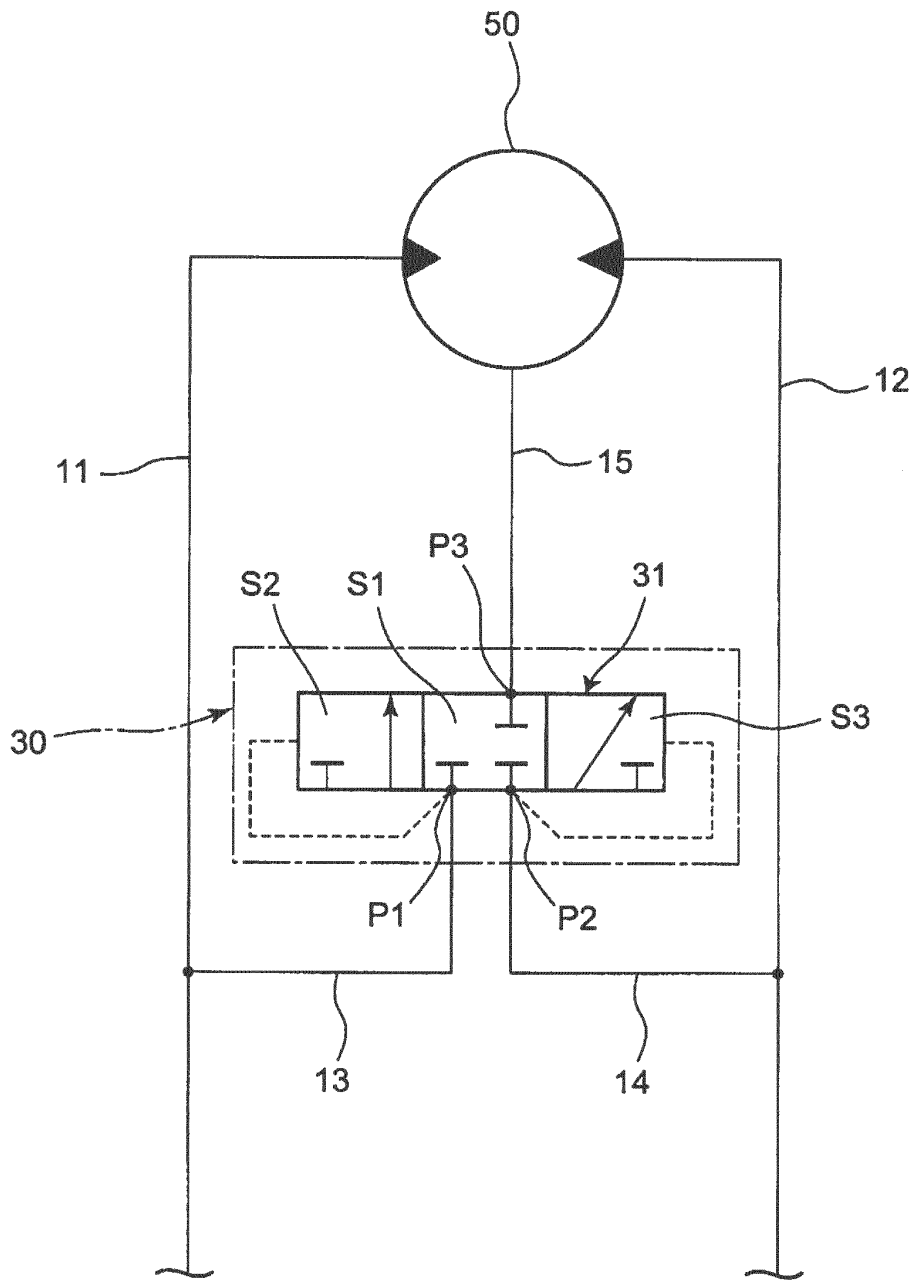


Fig 3



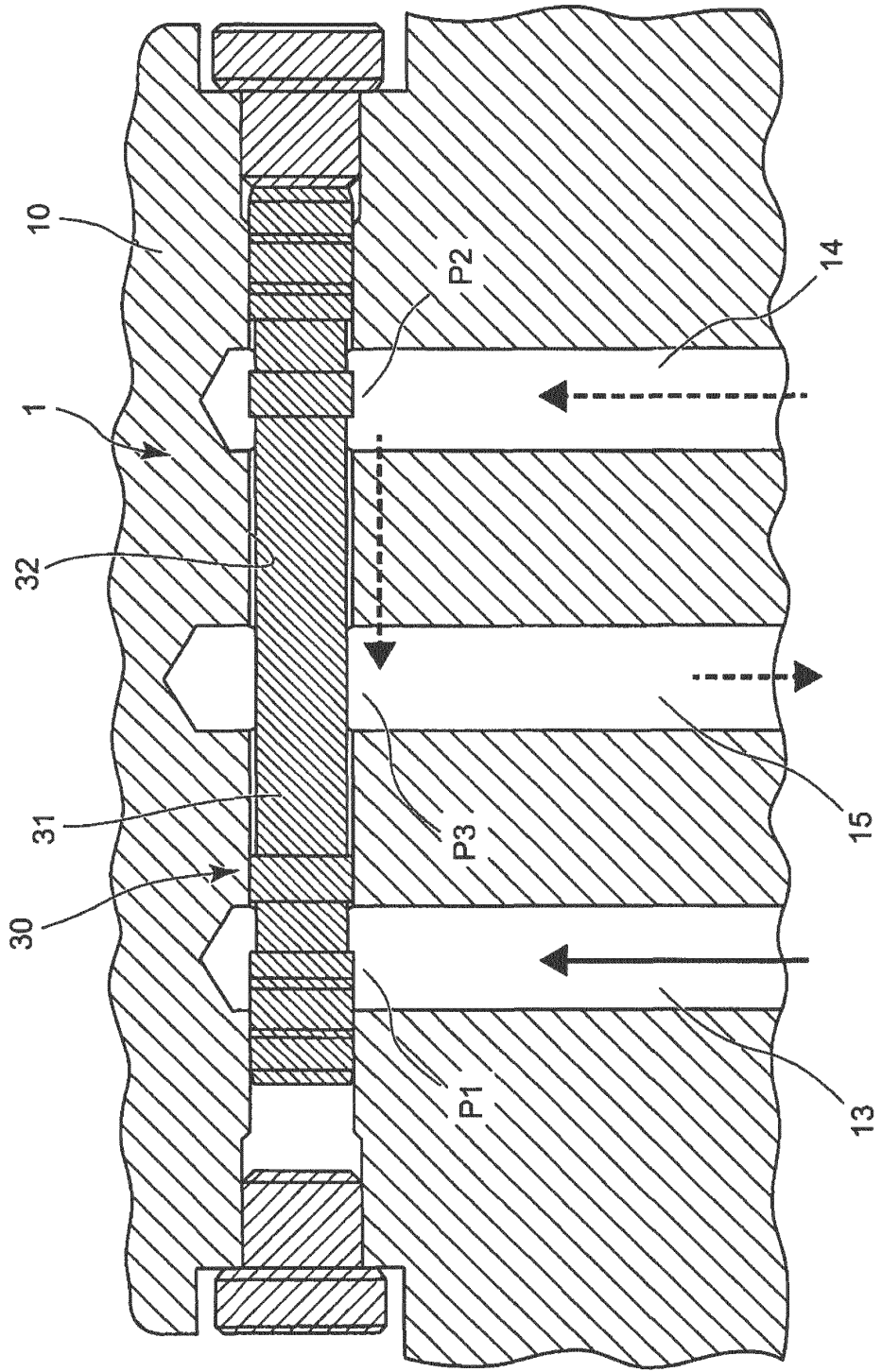
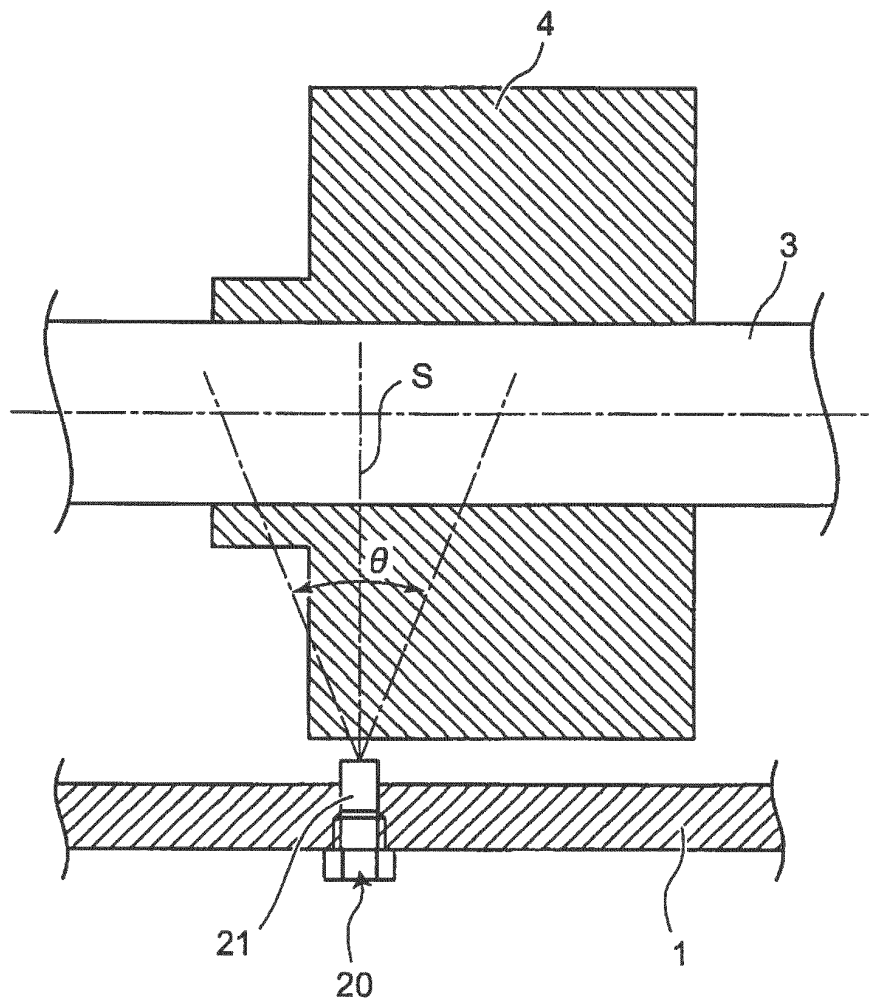


Fig 4

Fig 5



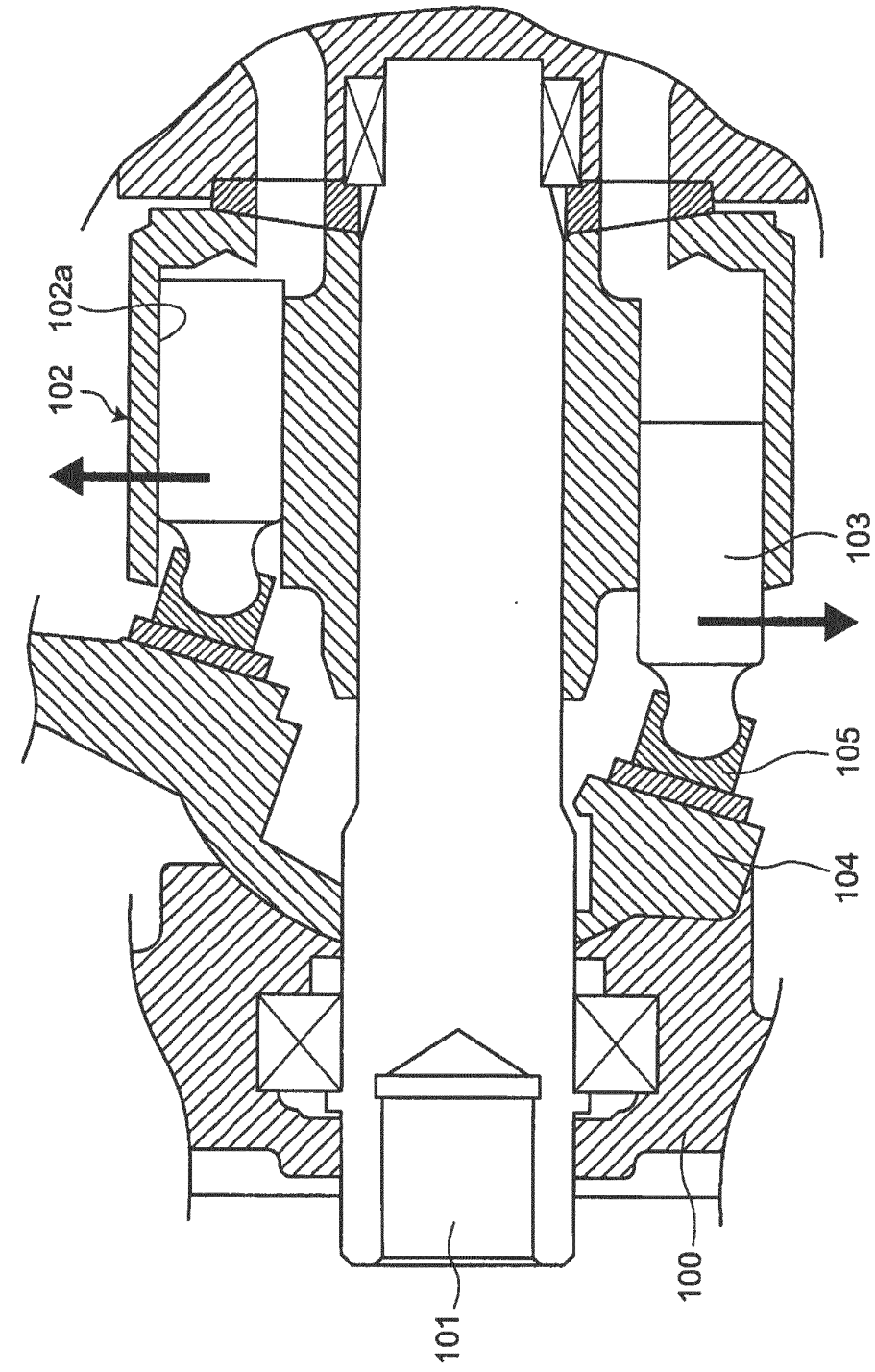


Fig 6

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/081730

5	A. CLASSIFICATION OF SUBJECT MATTER F03C1/253(2006.01) i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED	
	Minimum documentation searched (classification system followed by classification symbols) F03C1/253	
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014 Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
25	X Y	JP 55-21187 B2 (Aisin Seiki Co., Ltd.), 07 June 1980 (07.06.1980), entire text; all drawings (Family: none)
		Relevant to claim No. 1-4 5, 6
30	Y	JP 55-49162 A (H. Ikeuchi & Co., Ltd.), 09 April 1980 (09.04.1980), fig. 4 & US 4284239 A & GB 2033251 A & DE 2939951 A
		5
35	Y	JP 2000-246153 A (Kuroda Precision Industries Ltd.), 12 September 2000 (12.09.2000), fig. 2 (Family: none)
		5
40	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* 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 application or patent 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	
50	Date of the actual completion of the international search 24 January, 2014 (24.01.14)	Date of mailing of the international search report 04 February, 2014 (04.02.14)
55	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
	Facsimile No.	Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/JP2013/081730

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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**REFERENCES CITED IN THE DESCRIPTION**

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