(54) Title: COMPRESSOR HAVING OIL RETURNING APPARATUS

(57) Abstract: In a compressor including a sealed casing (110) respectively communicating with a suction pipe (112) and a discharge pipe (114); a cylinder assembly disposed in the sealed casing and having a suction path and a discharge path; a Z-plate (135) partitioning the internal space of the cylinder assembly into plural compression spaces and sucking, compressing and discharging gas while being rotated by a motor part; a vane contacted to the both surfaces of the Z-plate and partitioning each compression space into a suction region and a compression region while performing a reciprocating motion; and a discharge muffler (170) covered the both sides of the cylinder assembly and lowering noise of discharged gas, a compressor comprises at least one oil returning (200) member installed on a discharge route between the discharge path of the cylinder assembly and the discharge pipe of the sealed casing in order to filter oil flowing with gas.
Designated States (regional):
ARIPO patent (GH, GM, KE, LS, MW, MZ, 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, IE, IT, LU, MC, NL, PT, SE, SK, TR),
OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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.
COMPRESSOR HAVING OIL RETURNING APPARATUS

TECHNICAL FIELD

The present invention relates to a compressor using a vane, and more particularly, to a compressor having an oil returning apparatus which is capable of lowering oil leakage to outside of the compressor.

BACKGROUND ART

In general, compressors are for converting mechanical energy into compression energy of compressive fluid, among them a freezing compressor is largely classified into a reciprocating compressor, a scroll compressor, a centrifugal compressor and a rotary compressor, etc.

The present applicant has developed a Z-compressor with a novel concept, which can be classified as a rotary compressor, and filed an application for the invention to the Korean Industrial Patent Office (Application No. 10-1999-0042381, Application date: October 1, 1999), which has been laid open May 7, 2001 with a publication No. 2001-0035687.

The above-mentioned Z-compressor will be described in detail with reference to accompanying drawing.

Figure 1 is a longitudinal sectional view illustrating the conventional Z-compressor.

As shown in Figure 1, the Z-compressor can be classified as a rotary compressor, and it includes a sealed casing 10; a motor part 20 disposed in the
sealed casing 10 and generating a rotational force; and a compression part 30 for sucking, compressing and discharging gas by the rotational force of the motor part 20.

In the sealed casing 10, a side portion communicates with a suction pipe 12 at which gas is sucked, and a upper portion communicates with a discharge pipe 14.

In addition, a internal bottom surface of the sealed casing 10 is filled with a certain amount of oil for lubricating and cooling a sliding portion and a heat generating portion inside the sealed casing 10.

The motor part 20 consists of a stator 22 and a rotor 23 as a general electric motor.

The compression part 30 includes a cylinder assembly 31 disposed in the sealed casing 10 and forming a compression space for compressing gas sucked from the outside; a rotational shaft 24 for transmitting a rotational power generated in the rotor 23 of the motor part 20; a Z-plate 35 combined with the rotational shaft 24; rotated together with it and partitioning the compression space into a first space V1 and a second space V2; and a first vane 38 and a second vane 39 respectively contacted to the upper surface and the bottom surface of the Z-plate 35 and partitioning the first space V1 and the second space V2 into a suction region and a compression region.

The cylinder assembly 31 includes a cylinder 50; and a first bearing plate 40 and a second bearing plate 60 respectively fixed to the upper surface and the bottom surface of the cylinder 50 and forming a compression space.
with the cylinder 50.

Suction paths 52, 54 for sucking gas into the first space V1 and the second space V2 are respectively formed at the both sides of the cylinder 50 so as to communicate with the suction pipe 12.

The first and the second bearing plates 40, 60 are disc-shaped having a certain thickness and area, and they respectively include a journal portion 44, 64 extended from the center so as to have a certain height and outer diameter to receive the rotational shaft 24 rotatably; and a first vane slot 42 and a second vane slot 62 formed at the side of the journal portion 44, 64 to receive the first and the second vanes 38, 39.

In addition, a discharge path 46, 66 is respectively formed at the side of the first and the second vane slots 42, 62 to discharge compressed gas from the compression space.

In addition, in order to reduce discharge noise of the compression gas discharged to the upper portion of the first bearing plate 40 and the lower portion of the second bearing plate 60, a first discharge muffler 70 and a second discharge muffler 80 covered the first and the second bearing plates 40, 60 respectively.

In the first and the second discharge mufflers 70, 80, in order to engage with the outer circumference of the first and the second bearing plates 40, 60 in the circumference direction, they respectively have an inner diameter corresponded to the outer diameter of the first and the second bearing plates 40, 60, and fixation holes 74, 84 are formed at the central portion so as to have an
inner diameter corresponded to the outer diameter of the journal portions 44, 64 of the first and the second bearing plates 40, 60.

Accordingly, a side of the first and the second discharge mufflers 70, 80 is tightly contacted to the outer circumference of the journal portions 44, 64 of the first and the second bearing plates 40, 60 respectively, and the other side of the first and the second discharge mufflers 70, 80 is tightly contacted to the outer circumference of the first and the second bearing plates 40, 60 respectively.

In addition, outlets 72, 82 for discharging gas are respectively formed at a certain side of the first and the second discharge mufflers 70, 80.

The rotational shaft 24 has a certain outer diameter and a certain length, and it consists of a shaft portion 25 inserted into the journal portions 42, 62 of the first and the second bearing plates 40, 60 and a hub portion 26 circumferentially formed at the shaft portion 25 and combined with the Z-plate 35.

In addition, the rotational shaft 24 includes an oil path 27 penetrating the shaft portion 25 and an oil feeder 28 formed at the lower end of the oil path 27 to supply oil contained in the sealed casing 10 upwardly.

The Z-plate 35 has a disc shape to make the outer circumference of the Z-plate 35 slide-contact with the inner circumference of the cylinder 50 in the view of plane projection and formed as a sinuous cam surface having the same thickness from the inner circumference to the outer circumference in the view of side projection. Therefore, a surface of a top dead center is contacted to the
bottom surface of the first bearing plate 40 and is rotated, and a surface of a bottom dead center is tightly contacted to the upper surface of the second bearing plate 60 and is rotated.

The first and the second vanes 38, 39 have a square plate shape and tightly contact to the sinuous cam surface of the Z plate 35 in the compression spaces V1, V2 of the cylinder assembly 31. When the Z-plate 35 rotates in the compression space of the cylinder assembly 31, the first and the second vanes 38, 39 respectively divide the compression spaces V1, V2 into a suction region and a compression region while performing a reciprocating motion up and down according to high and low of the cam surface of the Z-plate 35.

In addition, the first and the second vanes 38, 39 are elastically supported by the elastic supporting member 90 installed at the first and the second bearing plates 40, 60 respectively.

The operation process of the conventional Z-compressor will be described.

First, when the rotational shaft 24 is rotated by the driving force of the motor part 20, the Z-plate 35 combined with the rotational shaft 24 in the cylinder assembly 31 is rotated simultaneously, and the gas suction, compression and discharge operations are performed.

In more detail, the first space V1 placed at the upper portion of the Z-plate 35 is divided into the suction region and the compression region on the basis of the top dead center of the Z-plate 35 and the first vane 38, the second space V2 placed at the lower portion of the Z-plate 35 is divided into the suction
region and the compression region on the basis of the bottom dead center of
the Z-plate 35 and the second vane 39. In that state, by the rotation of the
Z-plate 35, the top dead center and the bottom dead center of the Z-plate 35 are
moved, and accordingly a volume of the suction region and the compression
region of each space is varied.

Herein, the first and the second vanes 38, 39 reciprocate oppositely with
each other about the cam surface height of the Z-plate 35.

Accordingly, gas is simultaneously sucked into each suction region of
the first and the second spaces V1, V2 through the suction pipe 12 and the
suction paths 52, 54 and is gradually compressed, when the top dead center or
the bottom dead center of the Z-plate 35 reaches a discharge start point, the
compressed gas is simultaneously discharged to outside of the cylinder
assembly 31 through the discharge paths 46, 66 of each space V1, V2.
Afterward, the gas is discharged to the outside through the discharge pipe 14
after passing the first and the second discharge mufflers 70, 80 and the sealed
casing 10.

Herein, according to the rotation of the rational shaft 24, by the oil feeder
28 installed at the oil path 27 formed at the lower end of the rotational shaft 24,
the oil contained in (at the bottom surface of) the sealed casing 10 is sucked up
through the oil path 27, is dispersed at the upper end of the rotational shaft 24
and is supplied to sliding parts.

As described above, in the conventional Z-compressor, gas
compressed and discharged from the compression part and oil dispersed from
the upper end of the rotational shaft flow together.

According to it, the oil is discharged to outside of the sealed casing together with compressed gas discharged from the compression part, because the discharged oil remains behind on the lower portion or a bend portion, etc. of a pipe due to dropping pressure of gas while passing a cycle system, oil inside the sealed casing is gradually reduced. Accordingly, life-span of parts may be reduced due to dry abrasion on sliding parts by shortage of oil inside the sealed casing, and a performance of the compressor may be lowered due to increase of friction at sliding parts.

SUMMARY OF THE INVENTION

In order to solve the above-mentioned problems, it is an object of the present invention to provide a compressor having an oil returning apparatus which is capable of preventing oil leakage to outside of a sealed casing with discharged gas.

In order to achieve the above-mentioned object, in a compressor including a sealed casing respectively communicating with a suction pipe and a discharge pipe; a cylinder assembly disposed in the sealed casing and having a suction path and a discharge path; a Z-plate partitioning the internal space of the cylinder assembly into plural compression spaces and sucking, compressing and discharging gas while being rotated by a motor part; a vane contacted to the both surfaces of the Z-plate and partitioning each compression space into a suction region and a compression region while performing a
reciprocating motion; and a discharge muffler covered the both sides of the cylinder assembly and lowering noise of discharged gas, a compressor includes at least one oil returning member installed on a discharge route between a discharge path of a cylinder assembly and a discharge pipe of a sealed casing in order to filter oil flowing with gas.

**BRIEF DESCRIPTION OF DRAWINGS**

Figure 1 is a longitudinal sectional view illustrating the conventional Z-compressor;

Figure 2 is a longitudinal sectional view illustrating a Z-compressor having an oil returning apparatus in accordance with a first embodiment of the present invention;

Figure 3 is a partial sectional view illustrating part of an upper portion of a Z-compressor having an oil returning apparatus in accordance with a second embodiment of the present invention;

Figure 4 is a longitudinal sectional view illustrating major part of a Z-compressor having an oil returning apparatus in accordance with a third embodiment of the present invention; and

Figure 5 is a longitudinal sectional view illustrating major part of a Z-compressor having an oil returning apparatus in accordance with a fourth embodiment of the present invention.

**DETAILED DESCRIPTION OF THE INVENTION**
Hereinafter, the preferred embodiments of the present invention will be described with reference to accompanying drawings.

In the meantime, in description of the preferred embodiments of the present invention, in order to compare with the conventional Z-compressor, the present invention will be described on the basis of a Z-compressor, however, the embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the appended claims.

A Z-compressor in accordance with a first embodiment of the present invention will be described with reference to accompanying Figure 2.

Figure 2 is a longitudinal sectional view illustrating the Z-compressor in accordance with the first embodiment of the present invention.

The Z-compressor in accordance with the first embodiment of the present invention includes a sealed casing 110; a motor part 120 disposed in the sealed casing 110 and generating a rotational force; and a compression part 130 for sucking, compressing and discharging gas by the rotational force generated in the motor part 120.

The side surface of the sealed casing 110 communicates with a suction pipe 112 for sucking gas, the upper portion of the sealed casing 110 communicates with a discharge pipe 114 for discharging compressed gas; and
the bottom surface of the sealed casing 110 is filled with oil for lubricating sliding portions and cooling a heat generating portion of the sealed casing 110.

The motor part 120 consists of a stator 122 and a rotor 123 as a general electric motor.

The compression part 130 includes a cylinder assembly 131 installed inside the sealed casing 110 and forming a compression space at which gas sucked from the outside is compressed; a rotational shaft 124 for transmitting a rotational force generated in the rotor 123 of the motor part 120; a Z-plate 135 rotatably combined with the rotational shaft 124 and partitioning the compression space of the cylinder assembly 131 into a first space V1 and a second space V2; a first and a second vanes 138, 139 respectively contacted to the upper surface and the lower surface of the Z-plate 135 and partitioning each space V1, V2 into a suction region and a compression region when the Z-plate 135 is rotated; and a first and a second discharge mufflers 170, 180 respectively covered the both sides of the cylinder assembly 131 and lowering noise of compression gas propagated from the discharge path of the cylinder assembly 131.

The Z-compressor in accordance with the present invention has the same/similar construction with/to the conventional Z-compressor.

However, in the Z-compressor in accordance with the present invention, an oil returning member 200 is installed at a portion abutting on the discharge pipe 114 in order to filter oil flowing together with discharge gas.

In order to pass discharge gas and filter oil, the oil returning member
200 has a screen shape having a certain mesh and a thickness, and the outer circumference of the oil returning member 200 is tightly contacted to the inner circumference of the sealed casing 110 by a welding method, etc.

In the meantime, the oil returning member 200 can be fixed to the sealed casing 110 by using an additional supporting member.

In addition, it is preferable for the oil returning member 200 to have a size corresponded to the inner circumference of the sealed casing 110 so as to be tightly contacted to the inner circumference of the sealed casing 110.

The operation of the Z-compressor in accordance with the first embodiment of the present invention will be described.

First, when the rotational shaft 124 is rotated by the driving force of the motor part 120, the Z-plate 135 combined with the rotational shaft 124 inside the cylinder assembly 131 is simultaneously rotated, and accordingly the operation for sucking, compressing and discharging gas is performed.

In more detail, the first space V1 placed at the upper portion of the Z-plate 135 is divided into the suction region and the compression region on the basis of the top dead center of the Z-plate 135 and the first vane 138, and the second space V2 placed at the lower portion of the Z-plate 135 is divided into the suction region and the compression region on the basis of the bottom dead center of the Z-plate 135 and the second vane 139. In that state, by the rotation of the Z-plate 135, the top dead center and the bottom dead center of the Z-plate 35 are moved, and accordingly a volume of the suction region and the compression region is varied.
Herein, the first and the second vanes 138, 139 reciprocate oppositely with each other about the cam surface of the Z-plate 135.

Accordingly, gas is simultaneously sucked into each suction region of the first and the second spaces V1, V2 through the suction pipe 112 and the suction paths 152, 154 and is gradually compressed, when the top dead center or the bottom dead center of the Z-plate 135 reaches a discharge start point, the compressed gas is simultaneously discharged to outside of the cylinder assembly 131 through the discharge paths 146, 166 of each space V1, V2. Afterward, the gas is discharged to the outside through the discharge pipe 114 after passing the first and the second discharge mufflers 170, 180 and the sealed casing 110.

And, according to the rotation of the rational shaft 124, by the oil feeder 128 installed at the oil path 127 formed at the lower end of the rotational shaft 124, the oil contained in (at the bottom surface of) the sealed casing 110 is sucked up through the oil path 127, is dispersed at the upper end of the rotational shaft 124 and is supplied to sliding parts.

Herein, the compression gas discharged through the discharge paths 146, 166 of the cylinder assembly 131 is moved toward the discharge pipe 114 with oil, however, although the compressed gas passes the screen-shaped oil returning member 200 formed at the inlet of the discharge pipe 114 and is discharged to outside of the sealed casing 110 through the discharge pipe 114, the oil is filtered by the oil returning member 200 and is returned to the sealed casing 110. And, the returned oil lubricates the sliding parts of the sealed casing.
110.

In the Z-compressor in accordance with the first embodiment of the present invention, by including a screen-shaped oil returning member formed at an inlet of a discharge pipe, compression gas passes as it is, on the contrary, oil flowing with the compression gas is returned into a sealed casing, and accordingly dry abrasion at sliding portions due to shortage of oil inside the sealed casing can be prevented.

A compressor having an oil returning apparatus in accordance with a second embodiment of the present invention will be described with reference to accompanying Figure 3. Hereinafter, the same parts with the parts of the Z-compressor in accordance with the first embodiment will have the same reference numerals, and detailed description will be abridged.

Figure 3 is a partial-longitudinal sectional view illustrating a discharge pipe of the Z-compressor in accordance with the second embodiment of the present invention.

In the Z-compressor in accordance with the second embodiment of the present invention, an oil returning member 210 is inserted into and fixed at the inlet side of the discharge pipe 114 formed at the upper end of the sealed casing 110 so as to communicate with the casing 110.

The oil returning member 210 has a diameter corresponded to the inner diameter of the discharge pipe 114, is tightly inserted into the discharge pipe 114 by a welding or a press-fitting method, etc. and has a screen shape so as to pass discharged compression gas and filter oil flowing with the compression
gas.

In the Z-compressor in accordance with the second embodiment of the present invention, by fixedly inserting the screen-shaped oil returning member into the discharge pipe, it is possible to prevent dry abrasion due to shortage of oil at a sliding portion inside the sealed casing by returning oil flowing with compression gas into the sealed casing. In addition, the oil returning member can be easily fabricated and fixed, and because it has a simple structure, a production cost can be reduced.

A Z-compressor having an oil returning apparatus in accordance with a third embodiment of the present invention will be described with reference to accompanying Figure 4. Hereinafter, the same parts with the parts of the Z-compressor in accordance with the first and second embodiments will have the same reference numerals, and detailed description will be abridged.

Figure 4 is a longitudinal sectional view illustrating major parts of the Z-compressor in accordance with the third embodiment of the present invention.

In the Z-compressor in accordance with the third embodiment of the present invention, an oil returning member 220 is fixed between discharge paths 146, 166 respectively formed at the first and the second bearing plates 140, 160 and outlets 172, 182 of the first and the second discharge mufflers 170, 180.

The oil returning member 220 has a screen shape having a certain mesh to filter oil flowing with discharge gas.

Herein, the oil returning member 220 has a disc shape. In more detail,
the exterior of the oil returning member 220 is tightly contacted to the inner circumference of the first and the second discharge mufflers 170, 180 respectively covering the upper and the lower portions of the cylinder assembly 131 to lower noise of discharged gas by a welding method, etc., and the interior of the oil returning member 220 is tightly contacted to the outer circumference of the journal portions 144, 164 of the first and the second bearing plates 240, 260.

Accordingly, the compression gas discharged from the discharge path 146, 166 of the cylinder assembly 131 passes the oil returning member 220 and is charged through the outlets 172, 182 of the discharge mufflers 170, 180, on the contrary, oil inside the discharge mufflers 170, 180 is filtered by the oil returning member 220.

Accordingly, oil filtered by the oil returning member 220 is returned into the discharge mufflers 170, 180 and lubricates sliding portions of the vanes 138, 139 and the vane slots 142, 162, etc.

In the Z-compressor in accordance with the third embodiment of the present invention, by installing an oil returning member inside a discharge muffler, compression gas passes as it is, on the contrary, oil flowing with the compression gas is returned into the discharge muffler, and accordingly dry abrasion at sliding portions due to shortage of oil inside the discharge muffler can be prevented.

A Z-compressor having an oil returning apparatus in accordance with a fourth embodiment of the present invention will be described with reference to accompanying Figure 5. Hereinafter, the same parts with the parts of the
Z-compressor in accordance with the first, second and third embodiments will have the same reference numerals, and detailed description will be abridged.

Figure 5 is a longitudinal sectional view illustrating major parts of the Z-compressor in accordance with the fourth embodiment of the present invention.

As depicted in Figure 5, in the Z-compressor in accordance with the fourth embodiment of the present invention, an oil returning member 230 is inserted into the outlet 172 of the first and the second discharge mufflers 170, 180.

The oil returning member 230 is formed as a screen shape having a certain mesh so as to filter oil flowing with discharged gas.

Accordingly, the compressed gas discharged from a discharge path 146, 166 of the cylinder assembly 131 is discharged through the oil returning member 230 inserted into the outlets 172, 182 of the discharge mufflers 170, 180, on the contrary, oil is filtered by the oil returning member 230, is returned into the discharge mufflers 170, 180 and lubricates sliding portions of the vanes 138, 139 and the vane slots 142, 162, etc.

In the Z-compressor in accordance with the fourth embodiment of the present invention, by inserting-installing an oil returning member inside an outlet of a discharge muffler, compression gas passes as it is, on the contrary, oil flowing with the compression gas is returned into the discharge muffler, and accordingly dry abrasion at sliding portions due to shortage of oil inside the discharge muffler can be prevented. In addition, the oil returning member can
be easily fabricated and fixed.

**INDUSTRIAL APPLICABILITY**

In a Z-compressor in accordance with the present invention, by installing an oil returning member having a screen shape at a discharge route between a discharge path of a cylinder assembly and a discharge pipe of a sealed casing, oil flowing with discharged compression gas can be returned, and accordingly dry abrasion due to shortage of oil at sliding portions inside the sealed casing can be prevented.

The oil returning member in accordance with the present invention can be applied to a reciprocating compressor, a scroll compressor, a centrifugal compressor and a rotation compressor, etc. as well as a Z-compressor.
CLAIMS

1. In a compressor including a sealed casing respectively communicating with a suction pipe and a discharge pipe; a cylinder assembly disposed in the sealed casing and having a suction path and a discharge path; a Z-plate partitioning the internal space of the cylinder assembly into plural compression spaces and sucking, compressing and discharging gas while being rotated by a motor part; a vane contacted to the both surfaces of the Z-plate and partitioning each compression space into a suction region and a compression region while performing a reciprocating motion; and a discharge muffler covered the both sides of the cylinder assembly and lowering noise of discharged gas, a compressor, comprising:

   at least one oil returning member installed on a discharge route between the discharge path of the cylinder assembly and the discharge pipe of the sealed casing in order to filter oil flowing with gas.

2. The compressor of claim 1, wherein the oil returning member is formed as a screen shape having a certain mesh and is installed at an inlet side of the discharge pipe.

3. The compressor of claim 2, wherein the oil returning member is a plate type formed so as to be corresponded to a section of the sealed casing and be tightly contacted-fixed to the inner circumference of the sealed casing.
4. The compressor of claim 2, wherein the oil returning member is inserted into the discharge pipe.

5. The compressor of claim 1, wherein the oil returning member is formed as a screen shape having a certain mesh and is installed at an outlet side of the discharge muffler.

6. The compressor of claim 5, wherein the oil returning member is a plate type formed so as to be corresponded to a section of the discharge muffler and be tightly contacted-fixed to the inner circumference of the discharge muffler.

7. The compressor of claim 5, wherein the oil returning member is inserted into an outlet of the discharge muffler.

8. In a compressor including a sealed casing respectively communicating with a suction pipe and a discharge pipe; a motor part disposed in the sealed casing and generating a driving force; and a compression part for sucking, compressing and discharging gas by receiving the driving force of the motor part, the compressor having an oil returning apparatus, comprising:

   at least one oil returning member formed as a screen shape having a certain mesh and installed on a discharge route between the compression part and the discharge pipe of the sealed casing in order to filter oil flowing with gas.
### INTERNATIONAL SEARCH REPORT

**CLASSIFICATION OF SUBJECT MATTER**

IPC\(^7\): F04B 39/04, F04C 29/02

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\(^7\): F04B, F04C

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 practicable, search terms used)

**EPDOC, WPI, PAJ**

### DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>KR 2001 0035687 A (LG ELECTRONICS) Korean patent abstracts, 7 May 2001 (07.05.01) the whole document.</td>
<td>1-6,8</td>
</tr>
<tr>
<td>Y</td>
<td>US 4470778 A (MABE) 11 September 1984 (11.09.84) fig. 1.</td>
<td>1,2,4,8</td>
</tr>
<tr>
<td>Y</td>
<td>JP 61 112795 A (HITACHI) 30 May 1986 (30.05.86) fig. 1.</td>
<td>1,2,8</td>
</tr>
<tr>
<td>Y</td>
<td>JP 62 085193 A (MATSUSHITA REFRIG CO) 18 April 1987 (18.04.87) fig. 1.</td>
<td>1,5,6,8</td>
</tr>
<tr>
<td>Y</td>
<td>US 2001 0036417 A1 (HIOKI) 1 November 2001 (01.11.01) the whole document.</td>
<td>1,2,3,8</td>
</tr>
<tr>
<td>Y</td>
<td>US 6045344 A (TSUBOI) 4 April 2000 (04.04.00) fig. 1.</td>
<td>1,2,3,8</td>
</tr>
</tbody>
</table>

- See patent family annex.
- Further documents are listed in the continuation of Box C.

Date of the actual completion of the international search

20 February 2003 (20.02.2003)

Date of mailing of the international search report

12 March 2003 (12.03.2003)

Name and mailing address of the ISA/AT Austrian Patent Office

Kohlmarkt 8-10, A-1014 Vienna

Facsimile No. 1/53424/535

Authorized officer

THALHAMMER C.

Telephone No. 1/53424/358

Form PCT/ISA/210 (second sheet) (July 1998)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP A2 61112795</td>
<td>30-05-1986</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>JP A2 62085293</td>
<td>18-04-1987</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>KR A 20010035</td>
<td></td>
<td>none</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP A3 1107244</td>
<td>04-12-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP A2 01331973</td>
<td>30-11-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AU B2 547003</td>
<td>03-10-1985</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA A1 1222989</td>
<td>16-06-1987</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE C0 3175388</td>
<td>30-10-1986</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP B1 52234</td>
<td>24-09-1986</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP A2 57081187</td>
<td>21-05-1982</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP B4 59002800</td>
<td>20-01-1984</td>
</tr>
<tr>
<td>US A 6045344</td>
<td>04-04-2000</td>
<td>CH A 1213333</td>
<td>31-03-1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP A2 11052369</td>
<td>05-03-1999</td>
</tr>
</tbody>
</table>