



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 626 178 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.02.2006 Bulletin 2006/07

(51) Int Cl.:
F04C 18/02 ^(2006.01) **F04C 29/04** ^(2006.01)

(21) Application number: **04018870.8**

(22) Date of filing: **09.08.2004**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PL PT RO SE SI SK TR**
Designated Extension States:
AL HR LT LV MK

(71) Applicant: **ANEST IWATA CORPORATION**
Yokohama-shi,
Kanagawa-ken (JP)

(72) Inventor: **Muto, Ryusuke**
Yokohama-shi
Kanagawa (JP)

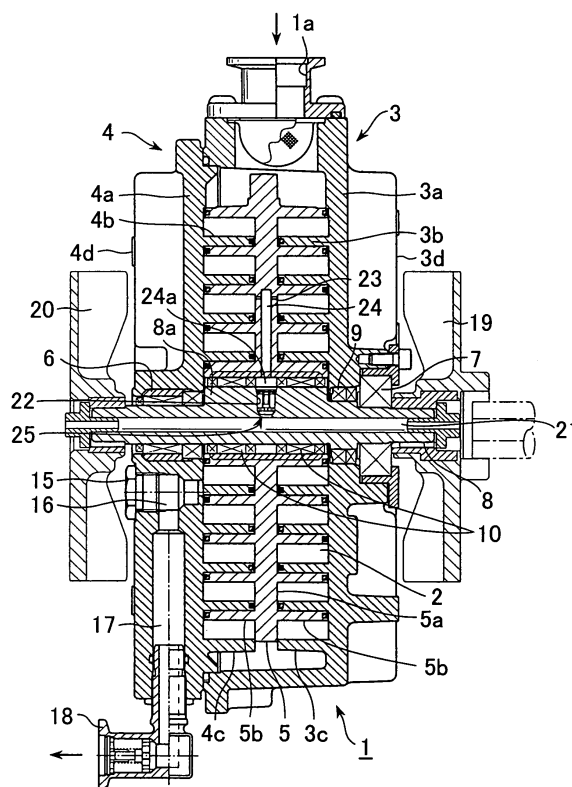
(74) Representative: **Ferreccio, Rinaldo**
c/o Botti & Ferrari S.r.l.
Via Locatelli 5
20124 Milano (IT)

(54) Scroll vacuum pump

(57) A scroll vacuum pump has an orbiting scroll (5) and fixed scrolls (3c, 4c). The orbiting scroll (5) is rotatably mounted to an eccentric portion (8a) of a driving shaft (8) and revolved by the driving shaft, so that a gas is sucked into a compression chamber (2) between the orbiting scroll and fixed scrolls through a sucking bore (1a).

External air is introduced through a ventilating hole (21) axially formed in the driving shaft (8) and into the compression chamber (2) via a check valve (25) that opens by centrifugal force when the driving shaft rotates, thereby cooling the eccentric portion (8a) and bearings to increase durability thereof. When the driving shaft (8) stops, the check valve (25) closes, so that a toxic gas in the compression chamber is not leaked to the outside to prevent environmental pollution.

FIG. 1



EP 1 626 178 A1

Description

Background of the invention

[0001] The present invention relates to a scroll vacuum pump and especially to a scroll vacuum pump in which a fixed wrap of a fixed scroll is engaged with an orbiting wrap of an orbiting scroll rotatably mounted to an eccentric portion of a driving shaft in a housing, the orbiting scroll being revolved at a certain eccentricity by the driving shaft so that a gas sucked through the outer circumference of the housing is compressed towards the center and discharged.

[0002] The scroll vacuum pump is known. In the scroll vacuum pump, operation time is too long, and the temperatures of the eccentric portion of the driving shaft and bearing and packing for supporting it are raised to cause the bearing and packing to be damaged, so that they become difficult to be used.

[0003] Thus, in the scroll vacuum pump, to increase durability, it is essential not to become excessive high temperature on the eccentric portion of the driving shaft even when operation time is too long.

[0004] To comply with the demand, the following measures are known among persons skilled in the art:

(1) Low-temperature or room-temperature air or nitrogen is introduced into a compressing region of the scroll vacuum pump and cools the region while diluting a toxic gas in the compressing region.

(2) A ventilating hole formed axially in the driving shaft allows low-temperature or room-temperature air or nitrogen to be discharged onto the bearing and to be introduced into the compressing region. After cooling to the region it is discharged.

(3) The eccentric portion of the driving shaft is hollow and low-temperature or room-temperature air is introduced into the eccentric portion to cool it.

[0005] JP 63-105294A discloses that an inert gas such as N_2 is introduced from the outside as the above (1) and that Fig. 5 thereof illustrates the gas flowing path in the eccentric portion of the driving shaft as the above (3).

[0006] However, there are problems in the technical measures. To introduce a low-temperature or room-temperature air or nitrogen into the compressing region, it is necessary for an introducing path to be provided therein and for means for supplying the gas to be provided outside. So its structure becomes complicate and larger to increase cost.

[0007] When the driving shaft rotates, the low-temperature or room-temperature air or nitrogen is introduced through the ventilating hole of the driving shaft to cool the bearings, but when the driving shaft stops, a toxic gas or impurity-including gas in the compressing region runs back and is discharged to the outside via the venti-

lating hole to cause environmental pollution.

Summary of the invention

[0008] In view of the disadvantages in the prior art, it is an object of the invention to provide a scroll vacuum pump in which external air is introduced into a compression chamber between an orbiting scroll and fixed scrolls to cool bearings to increase durability during operation while a toxic gas in the compression chamber is not leaked to the outside when it is not operated.

Brief description of the drawings

[0009] The features and advantages of the invention will become more apparent from the following description with respect to an embodiment as shown in appended drawings wherein:

Fig. 1 is a vertical sectional side view of one embodiment of a scroll vacuum pump according to the present invention;

Fig. 2 is an exploded vertical sectional view of a pin-crank-type self-rotation-preventing mechanism; and

Fig. 3 is an enlarged vertical sectional view of a check valve.

Detailed description of the preferred embodiment

[0010] Fig. 1 is a vertical sectional side view of a scroll vacuum pump of the present invention in which an orbiting scroll is revolved to forward a gas sucked through the outer circumference to a compressing region formed between the orbiting scroll and a fixed scroll, the gas being discharged close to the center after compressed.

[0011] Numeral 1 denotes a housing which has a sealed disc-like compression chamber 2, and comprises a casing 3 and a cover 4 with a sucking bore 1a on its circumference. The casing 3 and the cover 4 have fixed end plate 3a and 4a that surround the compression chamber 2. The fixed end plates 3a and 4a have spiral fixed wraps 3b and 4b respectively to form fixed scrolls 3c and 4c.

[0012] In the compression chamber 2 between the fixed end plates 3a and 4a, an orbiting scroll 5 is revolved around an axis of the compression chamber 2. The orbiting scroll 5 has orbiting wraps 5b, 5b engaged with the fixed scrolls 3c, 4c deviating by 180 degrees, and is rotatably mounted to an eccentric portion 8a of a driving shaft 8 with bearings 6, 7 at the center of the housing 1.

[0013] The orbiting end plate 5a is connected to the fixed end plate 3a with a three known pin-crank-type self-rotation-preventing mechanisms (not shown in Fig. 1). When the driving shaft 8 rotates, the orbiting plate 5a eccentrically revolves in the compression chamber 2

thereby changing the size of a sealed space between the fixed wraps 3b,4b and the orbiting wrap 5b engaged with each other.

[0014] As shown in Fig. 2, in the pin-crank-type self-rotation-preventing mechanism, a main shaft 11a of a pin-crank 11 is rotatably fitted in the fixed end plate 3a with a ball bearing 12, and a crank shaft 11b is fitted in a support bore 13 with a bearing 14 closer to the outer circumference of the orbiting plate 5a.

[0015] There is formed a through-bore 16 which communicates with the compression chamber 2 and is closed at the outer end by a plug 15 close to the center of the casing 4. A discharge bore 17 radially extends from the through bore 16 to the outer circumference of the casing 4. A discharge joint 18 is fitted over the discharge bore 17. The driving shaft 8 is driven by a motor (not shown) and cooling fans 19,20 are mounted to the driving shaft 8 closer to the outer ends of the casing 3 and the cover 4 respectively. Cooling fins 3d,4d are projected on the outer surfaces of the casing 3 and the cover 4 respectively.

[0016] According to the present invention, a ventilating hole 21 which communicates with external air at one end extends along the center of the driving shaft 8 and communicates with a valve bore 22 in the middle of the thickened eccentric portion 8a of the driving shaft 8. The valve bore 22 extends radially from the ventilating hole 21 to the outer circumferential surface of the eccentric portion 8a.

[0017] The orbiting end plate 5a has a discharge bore 24 which extends from the outer end of the ventilating hole 21 via a communicating path 24a radially and opens via a smaller-diameter outlet 23 to a low-pressure area in the middle of the radius of the compression chamber 2 formed between the fixed wraps 3b,4b and the orbiting wrap 5b.

[0018] In the valve bore 22, there is a check valve 25 which opens outward radially, but does not open inward.

[0019] The check valve 25 is shown in Fig. 3.

[0020] A smaller-diameter valve seat 22a is formed at the inner end radially of the valve bore 22, and a larger-diameter portion 22b is formed at the outer end. A valve disc 26 has a tapered portion at the lower end and a cylindrical portion which has a plurality of vertical grooves 26a on the outer circumferential surface. The tapered portion of the valve disc 26 is fitted on the valve seat 22a when the valve bore 22 is closed by the check valve 25. A support plate 27 which has a discharge opening 27a is provided on the larger-diameter portion 22b.

[0021] A valve shaft 28 extends vertically from the center of the valve disc 26 into the support plate 27, and the valve shaft 28 is surrounded by a compression spring 29 between the valve disc 26 and the support plate 27.

[0022] In the scroll vacuum pump, while strength of the compression spring 29 of the check valve 25 is determined to achieve the object described later, the sucking bore 1a is connected to a sealed container (not shown) to be depressurized or evacuated when the valve disc

26 is closed. The sealed container contains a toxic gas such as HCl. The driving shaft 8 is driven while the ventilating hole 21 of the driving shaft 3 communicates with external air.

[0023] With rotation of the driving shaft 8, the orbiting scroll 5 pivotally mounted thereto is revolved at a certain eccentricity while it is engaged with the fixed scrolls 3c,4c. Accordingly, the sealed container connected to the sucking bore 1a is gradually depressurized and evacuated, so that the toxic gas is sucked into the compression chamber 2 in the scroll vacuum pump.

[0024] When the rotation speed of the driving shaft 8 exceeds a certain value, the valve disc 26 of the check valve 25 is subjected to centrifugal force produced thereby, and moved radially against the compression spring 29 to open.

[0025] Meanwhile, the compression chamber 2 in the scroll vacuum pump is compressed, but has always lower pressure than atmospheric pressure.

[0026] When the valve disc 26 is allowed by the centrifugal force to move away from the valve seat 22a, air introduced from the outside into the valve bore 22 via the ventilating hole 21 flows into the discharge bore 24 through the grooves 26a of the valve disc 26 and the opening 27a of the support plate 27. Finally the air is sucked into the compression chamber between the fixed and orbiting scrolls 3c,4c,5 through the outlets 23.

[0027] Hence the eccentric portion 8a of the driving shaft 8, and the bearings 9,10 and packing around it are cooled by the air introduced from the outside through the outlets 23, thereby increasing durability.

[0028] When operation stops, the check valve 25 is automatically closed thereby preventing the toxic gas in the compression chamber 2 from being discharged to the outside. So environment is not contaminated by the toxic gas.

[0029] The fixed and orbiting scrolls in the embodiments have two-sides, but the present invention may be also applied to a one-side scroll.

[0030] The foregoing merely relates to embodiments of the invention. Various changes and modifications may be made by a person skilled in the art without departing from the scope of the claims.

Claims

1. A scroll vacuum pump comprising:

- a housing;
- a driving shaft along a center of the housing, said driving shaft having an eccentric portion,
- a fixed scroll fixed in the housing, said fixed scroll having a fixed wrap; and
- an orbiting scroll rotatably mounted around the eccentric portion of the driving shaft and having an orbiting wrap, the orbiting scroll being revolved eccentrically by the driving shaft so that

a gas sucked through an outer circumference of the housing is compressed toward the center of the housing in a compression chamber between the fixed and orbiting wraps engaged with each other and discharged, thereby sucking a gas into the compression chamber, 5

said driving shaft having a ventilating hole that communicates with outside and extends axially therein, a valve bore that radially extends communicating with the ventilating hole at one end 10 and opening to the compression chamber at the other end, said valve bore having a check valve that opens by centrifugal force when the driving shaft rotates thereby introducing external air into the compression chamber for cooling, while the 15 check valve closes when the driving shaft stops thereby preventing the gas from being leaked from the compression chamber to the outside.

2. A scroll vacuum pump as claimed in claim 1 wherein 20 the orbiting stroke has a discharge bore from the valve bore to outlets that open to the compression chamber.

25

30

35

40

45

50

55

FIG. 1

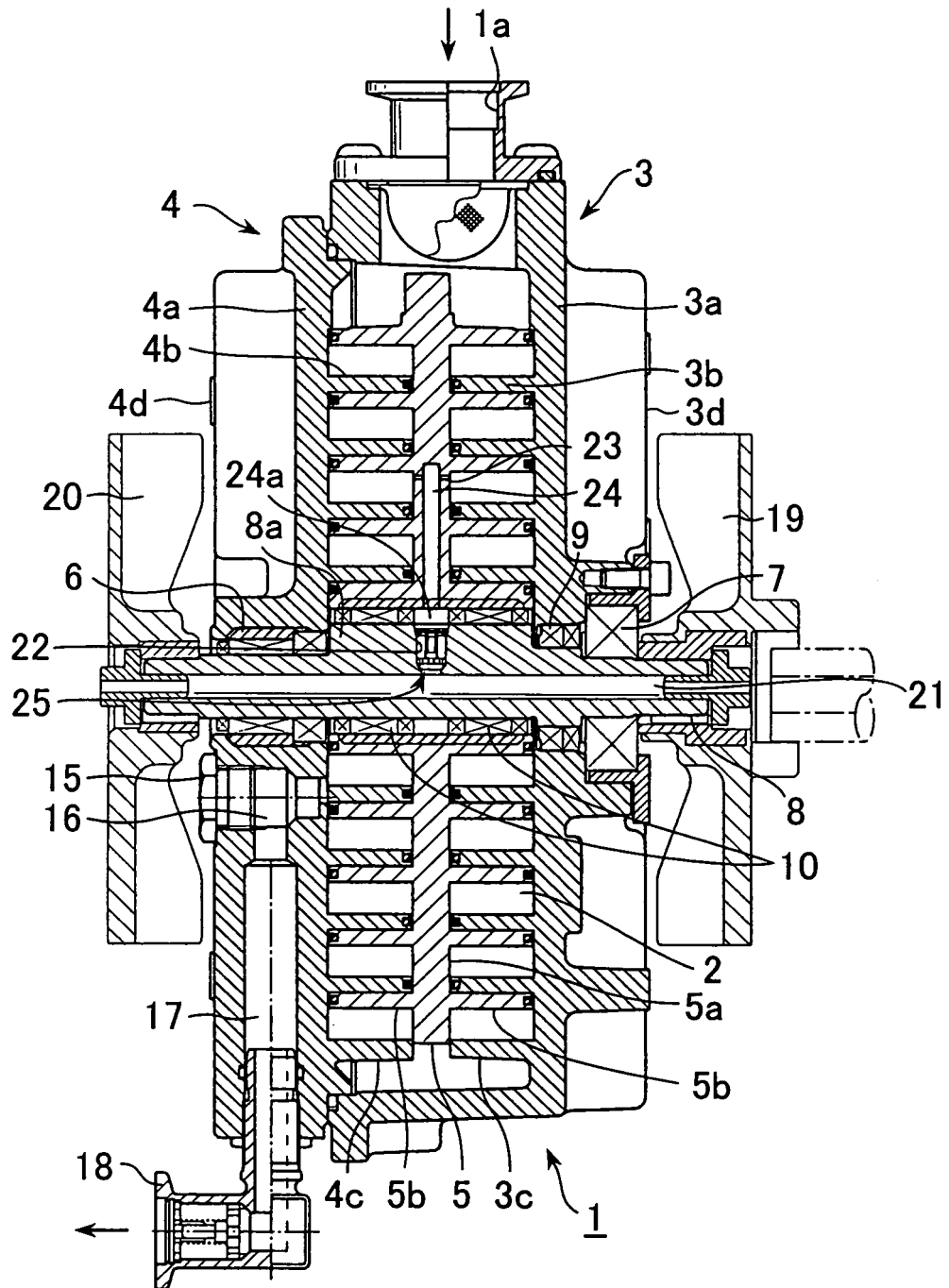


FIG. 2

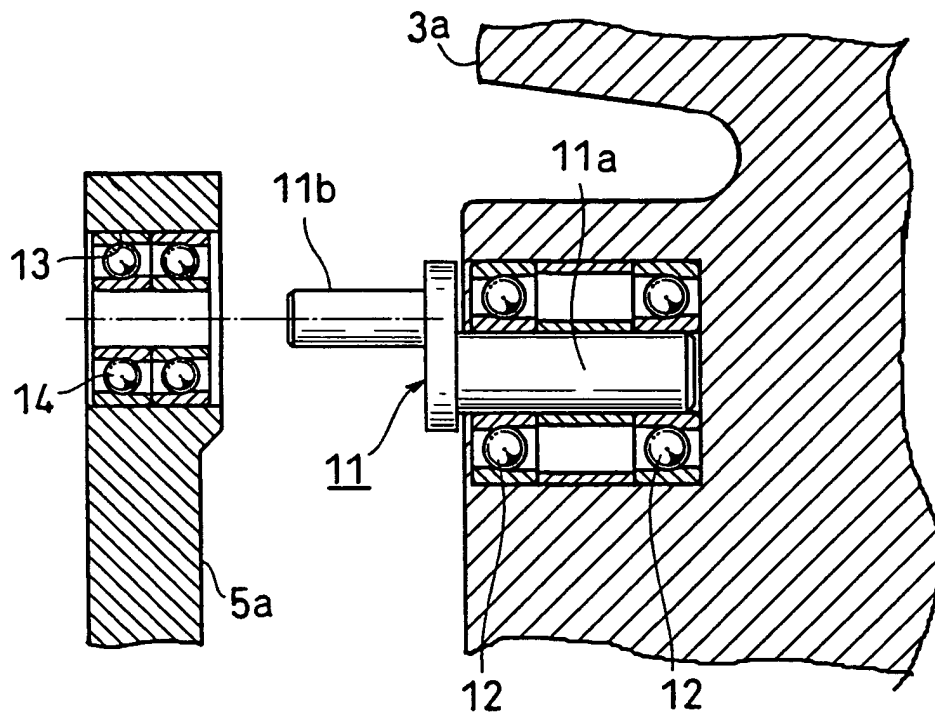
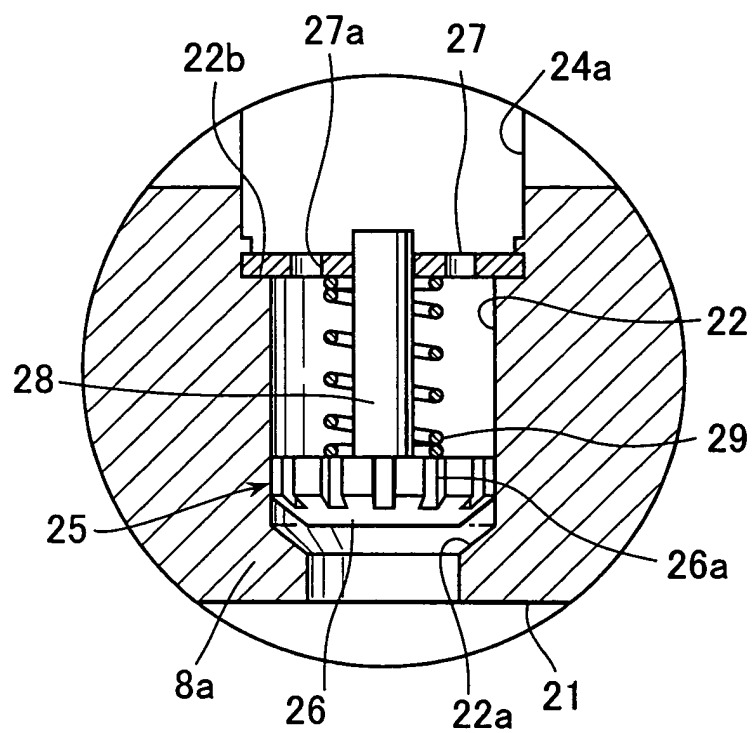


FIG. 3





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 01 8870

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A,D	PATENT ABSTRACTS OF JAPAN vol. 0123, no. 46 (M-742), 16 September 1988 (1988-09-16) & JP 63 105294 A (HITACHI LTD; others: 01), 10 May 1988 (1988-05-10) * abstract *	1,2	F04C18/02 F04C29/04
A	----- EP 0 777 053 A (ANEST IWATA CORP) 4 June 1997 (1997-06-04) * abstract; figure 1 *	1,2	
A	----- US 2002/085937 A1 (ISOMURA KENJI ET AL) 4 July 2002 (2002-07-04) * abstract; figure 1 *	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F04C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 January 2005	Examiner Descoubes, P
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			

1
EPO FORM 1503 03 82 (P04C01)

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

EP 04 01 8870

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.

04-01-2005

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 63105294	A	10-05-1988	JP 2023216 C	26-02-1996
			JP 7058077 B	21-06-1995

EP 0777053	A	04-06-1997	JP 3423514 B2	07-07-2003
			JP 9151868 A	10-06-1997
			DE 69627457 D1	22-05-2003
			DE 69627457 T2	26-02-2004
			DE 69631447 D1	04-03-2004
			DE 69631447 T2	16-09-2004
			EP 1146232 A2	17-10-2001
			EP 0777053 A1	04-06-1997
			US 6109897 A	29-08-2000
			US 6186755 B1	13-02-2001
			US 5842843 A	01-12-1998

US 2002085937	A1	04-07-2002	JP 2002180978 A	26-06-2002
			DE 10160722 A1	02-10-2002
