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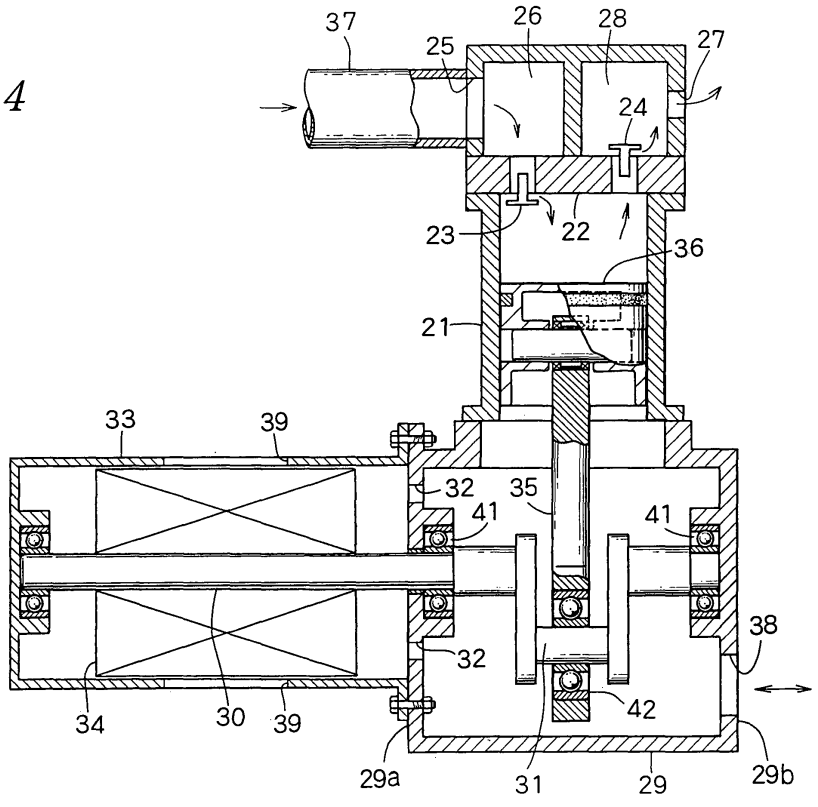
(54) Booster-type gas compressor

(57) In a booster-type gas compressor, an electric motor in a motor case drives a crank shaft integrally connected to a driving shaft. The crank shaft is coupled to a piston rod extending perpendicular to the crank shaft and having a piston at the upper end. Rotation of the crank shaft allows the piston up and down. A compressed gas from a compressed-gas flow path is fed to a compressing chamber above the piston and further compressed by the piston. A bypath conduit connects the compressed-gas flow path to the motor case to keep pressure in the crank case to more than atmospheric pressure.

FIG.4



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a booster-type gas compressor in which a compressed gas is further compressed by a reciprocating piston.

[0002] As shown in Fig. 4, a suction valve 23 is provided at one side of a top wall 22 of a cylinder 21 and a discharge valve 24 is provided at the other side of the top wall 22. Above the suction valve 23 and the discharge valve 24, there are a suction chamber 26 having an inlet 25 and a discharge chamber 28 having an outlet 27 respectively. Under the cylinder 21, a crank shaft 31 integrally formed with a driving shaft 30 in a crank case 29 is provided. The driving shaft 30 is driven by an electric motor 34 in a motor case 33 mounted to a side wall 29a of the crank case 29 so that a gas may pass through. A piston 39 is moved up and down in a cylinder 21 via a piston rod 35 by the crank shaft 31 formed with the driving shaft 30 to compress a gas such as N_2 introduced in a compressing chamber above the piston 36 via the suction valve 23 and to discharge it from the discharge valve 24 and outlet 27.

[0003] In such a reciprocating-piston-type gas compressor, with reciprocating motion of the piston 36, a compressed gas in the compressing chamber above the piston 36 in the cylinder 21 partially leaks through around the piston 36 into the crank case 29.

[0004] The compressed gas in the crank case 29 Is partially discharged from an air hole 38 of the crank case 29 to produce loss of energy. Leak of a toxic gas causes air pollution.

[0005] Furthermore, in case that such a reciprocating-piston-type gas compressor comprises a booster-type gas compressor sucking a compressed gas and compressing it to higher pressure, in a suction step of restarting or unloading operation, the compressing chamber becomes decompression condition in which a atmospheric pressure gas from an air hole 38 of the crank case 29 flows through around the piston 36 to the compressing chamber above the piston 36 and is mixed in a gas from the suction hole 25 to render density lowered.

[0006] To cool the electric motor 34, a ventilating hole 39 is formed in the electric motor case 33 or a fan is mounted to the driving shaft 30 to achieve forcing cooling. Thus, the electric motor 34 cannot be completely sealed to render noise leaked or dusts, and solid ingredients in external air are likely to remain in the electric motor 34 or motor case 33.

[0007] Furthermore, in such a booster-type gas compressor, atmospheric pressure remains in the crank case 29. So, owing to pressure difference above and under the piston 36, torque variation in one rotation becomes greater to increase an electric current of the electric motor 34 directly mounted to the crank case 29 to speed up damages on the outer circumferential surface of the piston 36, a piston ring, the driving shaft 30, bearings 41,42 of the crank shaft 31 and a seal of a sliding portion.

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide a booster-type gas compressor comprising a reciprocating piston, pressure difference being reduced between a compressing chamber above the piston and a crank case under the piston thereby preventing wear of each part and unsmoothness of the operation.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Fig. 1 is a vertical sectional view of the first embodiment of a booster-type gas compressor according to the present invention;
Fig. 2 is a vertical sectional view of the second embodiment of a booster-type gas compressor according to the present invention;
Fig. 3 is a vertical sectional view of the third embodiment of a booster-type gas compressor according to the present invention; and
Fig. 4 is a vertical sectional view of a known booster-type gas compressor

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0010] Fig. 1 shows the first embodiment of a booster-type gas compressor according to the present invention.

[0011] The basic structure of the booster-type gas compressor is not so different from that in Fig. 4. The same numerals are allotted to the same members. Its description is omitted and only differences are described.

[0012] In Fig. 1, there is no air hole 38 communicating external air and a compressed-gas introducing hole 11 is formed in an electric motor case 36 instead of a ventilating hole.

[0013] A compressed-gas feeding path 37 is connected to a compressed-gas introducing hole 11 via a bypath conduit 14 comprising a check valve 12 that closes towards the compressed-gas feeding path 37 and opens in an opposite direction and a pressurre regulator 13 such as a pressure-regulating valve or a pressure reducing valve.

[0014] By opening a valve (not shown), a compressed gas is fed into a suction chamber 26 and partially introduced into the crank case 29 via the bypath conduit 14 comprising the check valve 12 and the pressure regulator 13, the compressed-gas introducing hole 11. a motor case 33 and a communicating hole 32 to let the inside of the crank case 29 compressed to more than atmospheric pressure.

[0015] The compressed gas in the compressed-gas feeding path 37 is partially fed into the crank case 29, so that gas pressure in the crank case 29 becomes more than atmospheric pressure different from a known device.

[0016] Thus, difference in pressure between a compressing chamber above a piston 36 in a cylinder 21 and the inside of the crank case 29 becomes smaller than that in a known device, thereby preventing sliding of the piston 36 from lacking smoothness and preventing each of the bearings 41,42 and preventing a seal from reducing their lives or producing looseness caused by unequal force.

[0017] By the pressure regulator 13, pressure of a compressed gas in the crank case 29 is regulated, so that pressure difference from a compression chamber above the piston 37 is regulated as soon as possible thereby achieving stable performance.

[0018] As shown in Fig. 2, a pressure regulator 15 may be directly joined to the crank case. The pressure regulator 15 may be a reserve tank comprising a pressure-regulating valve and a check valve thereby achieving similar advantage to that in Fig. 1.

[0019] In Fig. 3, a compressed-gas feeding path 37 is connected to a compressed-gas introducing hole 11 of a motor case 33 via a bypath conduit 14 comprising a check valve 12 that closes towards the compressed-gas feeding path 37 and opens in an opposite direction. A pressure regulator 13 is provided on the compressed-gas feeding path 37 between the bypath conduit 14 and a suction valve 23 thereby achieving similar advantage to that in Fig. 1.

[0020] 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 claims wherein:

Claims

1. A booster-type gas compressor comprising:

a crank case;
a crank shaft in the crank case;
a driving shaft integrally connected to the crank shaft;
a motor case;
an electric motor joined to the driving shaft to drive the driving shaft in the motor case;
a cylinder;
a piston in the cylinder;
a piston rod joined to the piston at an upper end and to the crank shaft at a lower end;
a compressed-gas flow path that feeds a compressed gas into a compressing chamber above the piston to further compress the gas; and
a bypath conduit that connects the compressed-gas flow path to the crank case to keep pressure in the crank case to more than atmospheric pressure.

2. A compressed of claim 1 further comprising a pressure regulator at the bypath conduit.

3. A compressor of claim 1 further comprising a pressure regulator at the crank case.

4. A compressor of claim 1 further comprising a pressure regulator at the compressed-gas flow path between the bypath conduit and the cylinder.

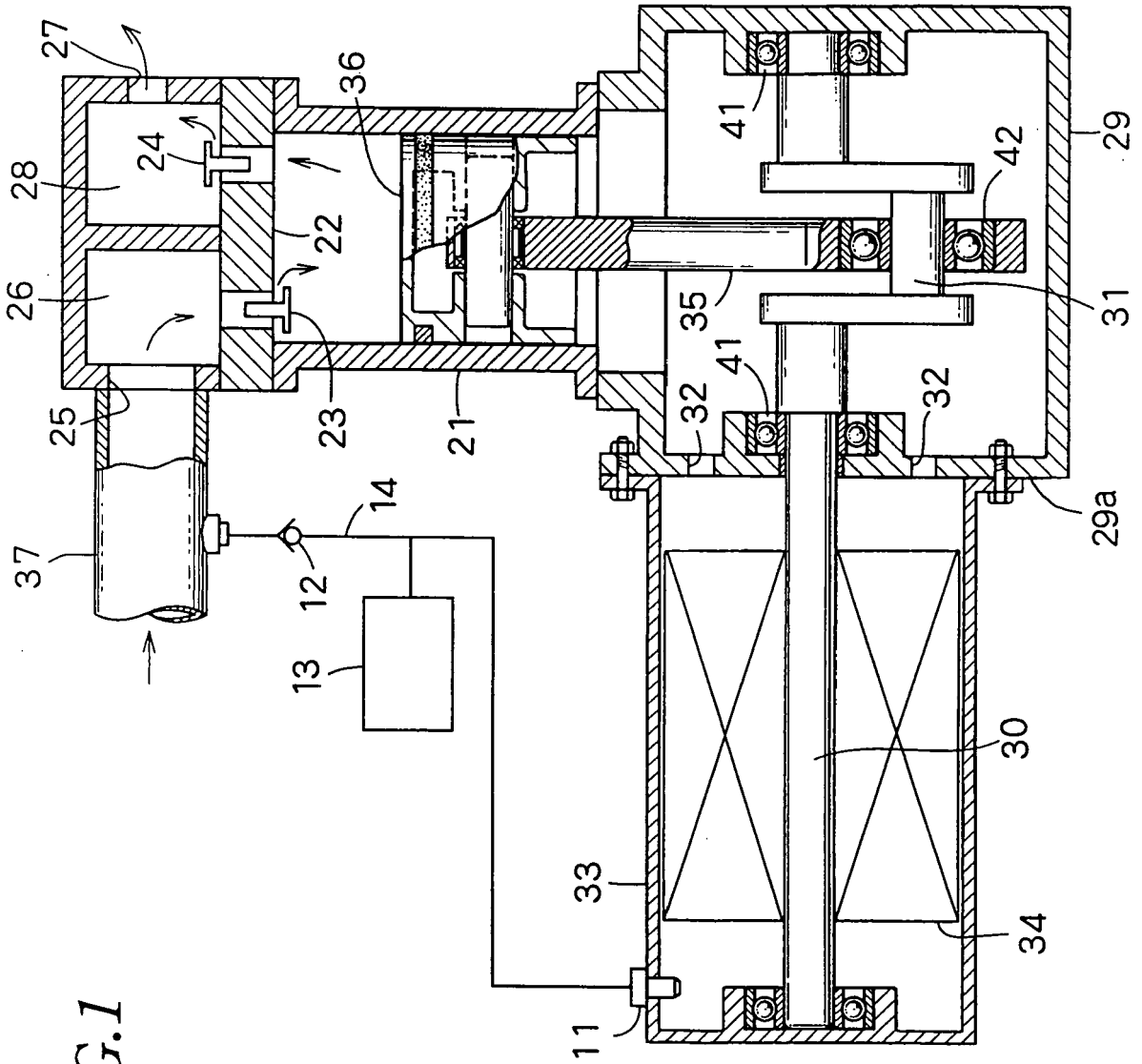
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FIG.1

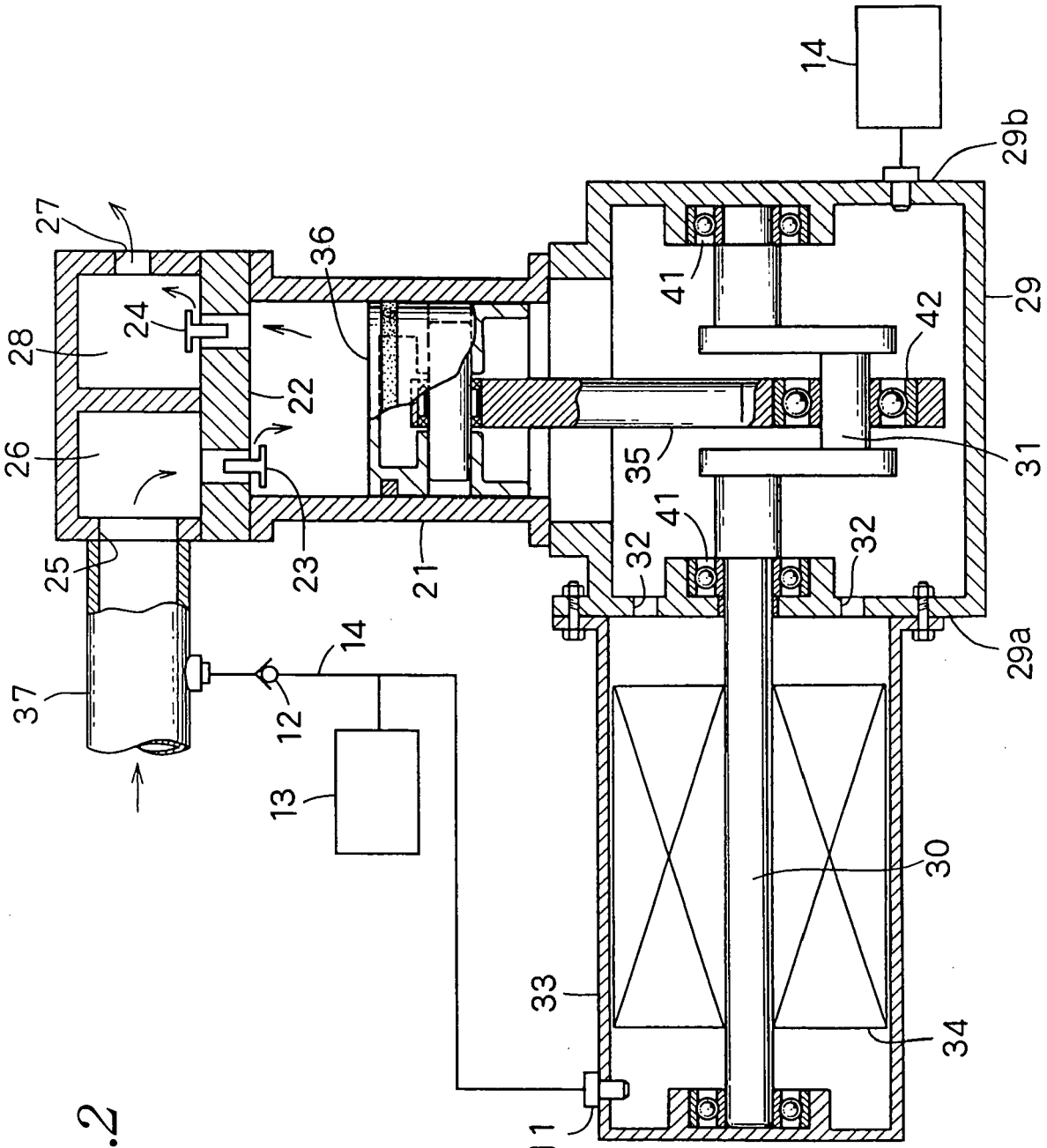
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FIG.2

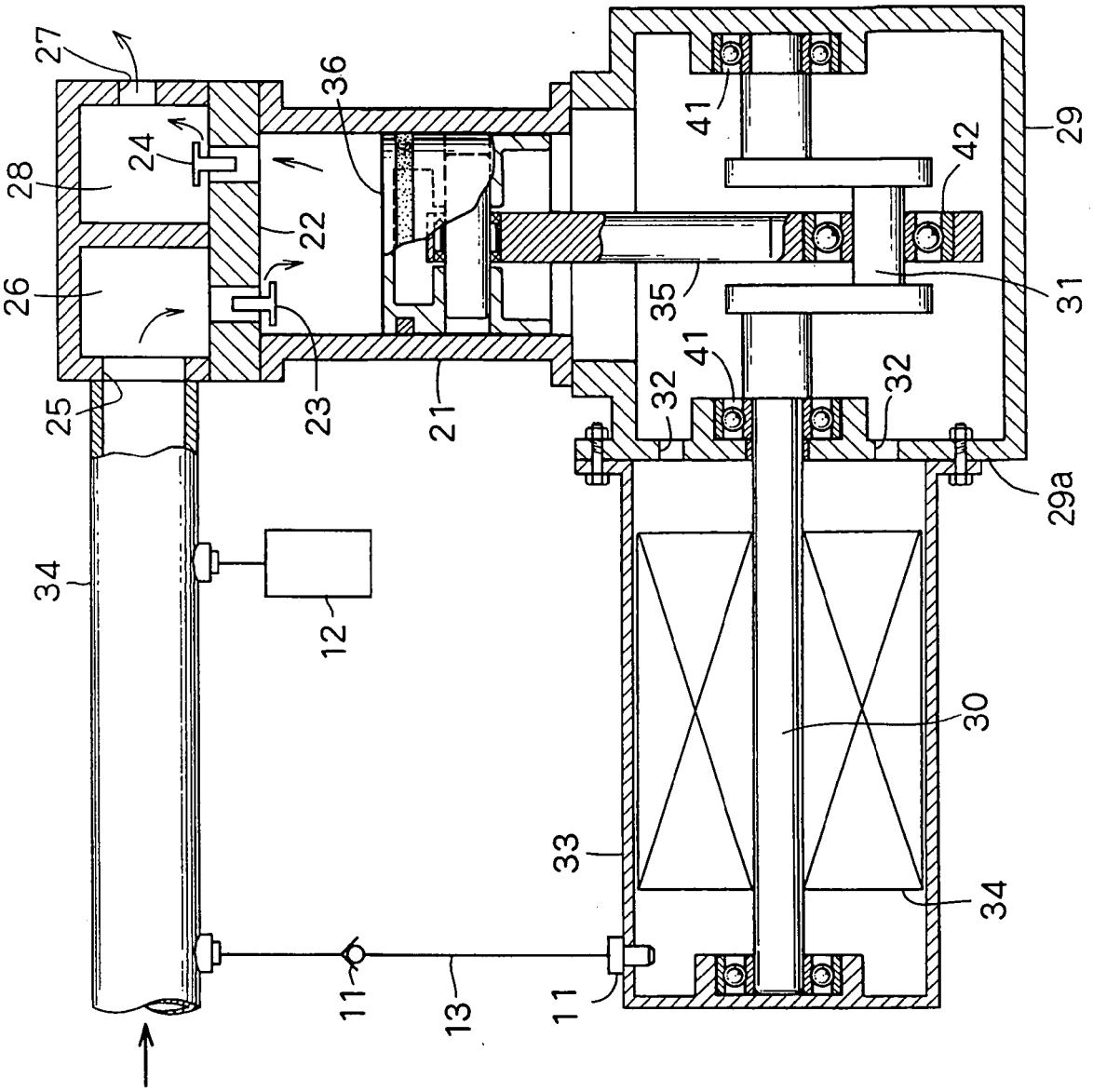
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FIG.3

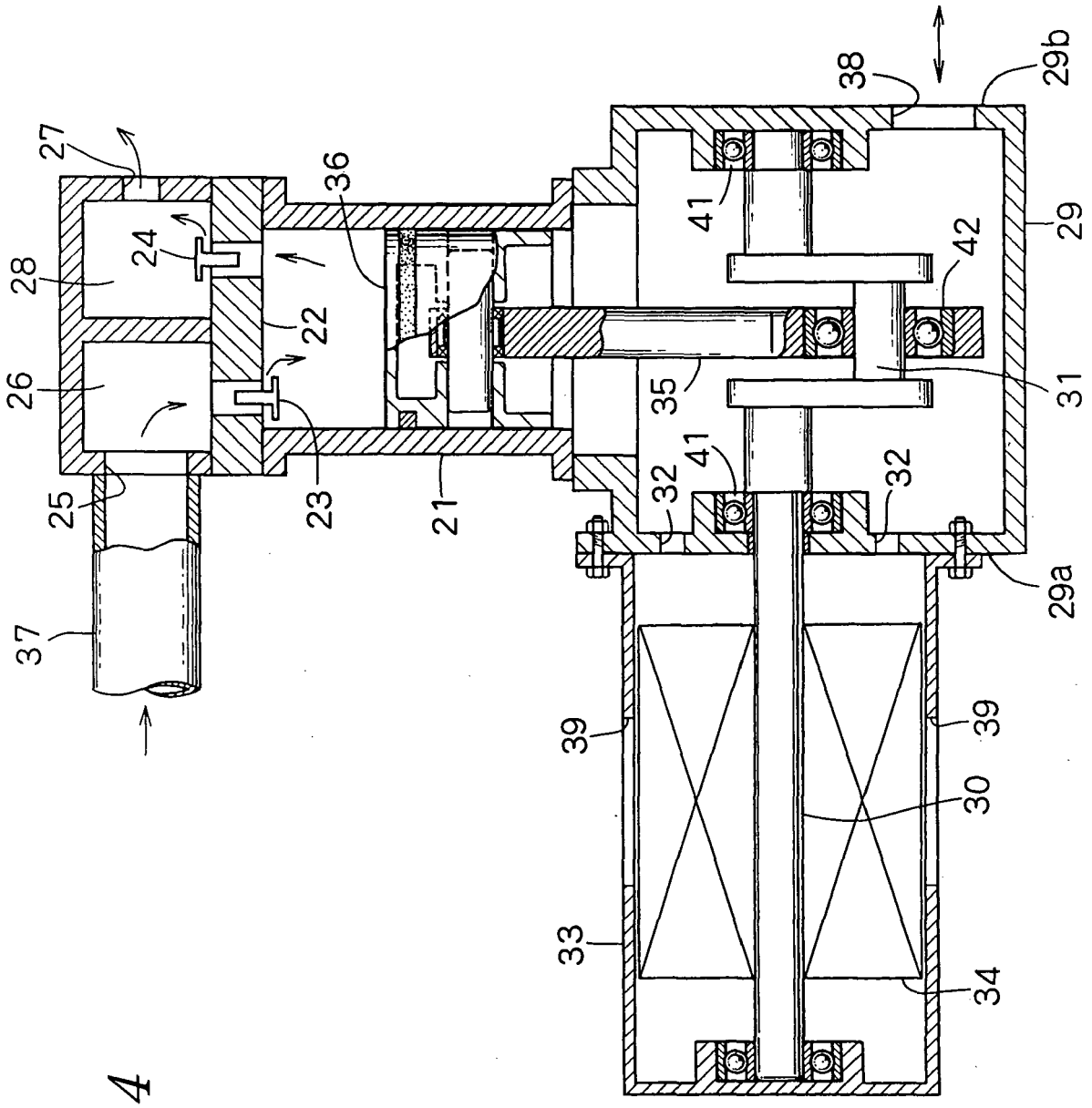
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FIG.4

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EUROPEAN SEARCH REPORT

Application Number
EP 07 00 0101

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	JP 05 157050 A (MITSUBISHI HEAVY IND LTD) 22 June 1993 (1993-06-22) * abstract; figure *	1-4	
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A	GB 1 244 105 A (BITZER KUEHLMASCHB G M B H [DE]) 25 August 1971 (1971-08-25) * figure 2 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 February 2007	Pinna, Stefano

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 00 0101

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
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27-02-2007

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