



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
25.05.2005 Bulletin 2005/21

(51) Int Cl.7: **F04C 18/16, F04C 29/00**

(21) Application number: **03728116.9**

(86) International application number:
PCT/JP2003/006260

(22) Date of filing: **20.05.2003**

(87) International publication number:
WO 2003/098047 (27.11.2003 Gazette 2003/48)

(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 PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

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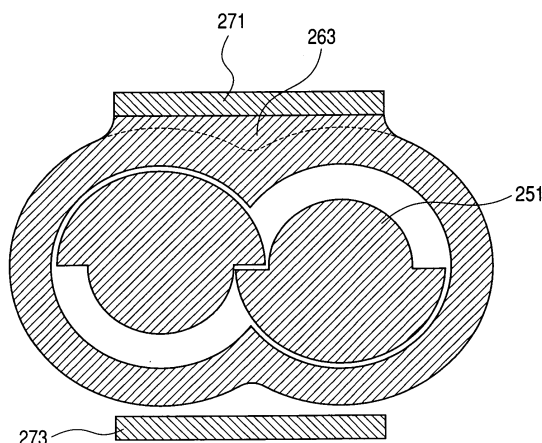
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(54) **VACUUM PUMP**

(57) The invention relates to a heat insulation structure having the function of retaining a high temperature in a vacuum exhaust chamber in a rotary type vacuum pump and the function of cooling bearings at the same time, and particularly has for its object the provision of a structure for preventing bearings or shaft seals from becoming so high in temperature as to be damaged when a high temperature is to be retained in an exhaust chamber with respect to a vacuum pump for exhausting reactive gases as in a semiconductor process. As a means to achieve the object, in a vacuum pump com-

prising an introduction means having a vacuum exhaust chamber and adapted to introduce a process gas into the vacuum exhaust chamber, an exhaust means for exhausting the process gas out of the vacuum exhaust chamber, a housing for separating the vacuum exhaust chamber from outside, with a rotor installed for rotation in the housing through a bearing, a heat insulation means is provided between the vacuum exhaust chamber and the bearing. Further, a metal whose thermal conductivity is higher than that of the material of the housing is incorporated as a heat transmission means into the housing.

FIG. 3



Description

Technical Field

[0001] The present invention relates to a structure of protecting a bearing or the like against heat generated at inside of an exhaust chamber of a vacuum pump, particularly relates to a structure of preventing a bearing or a shaft seal from being destructed by elevating a temperature thereof while maintaining an exhaust chamber at a high temperature relative to a vacuum pump for exhausting a reactive gas as in a semiconductor process.

Background Art

[0002] According to a rotary vacuum pump for making a reactive gas flow of a background art, there poses a problem that a reaction product is piled up at an exhaust path to close the exhaust path of an exhaust port or a problem that the product is adhered to inside of the exhaust chamber, a rotating rotor or the like and the rotor or the like is not rotated. In order to resolve the problem, there has been adopted a method of elevating a temperature of inside of the exhaust chamber such that the product is not solidified by elevating a temperature of the housing by utilizing heat generated in vacuuming or winding a heater around an outer periphery of the housing of the vacuum pump. However, in the case of a rotary vacuum pump having a rotating shaft, when a temperature of a housing forming the exhaust chamber is elevated, there poses a problem that heat is conducted also to a bearing fixed to the housing to elevate a temperature of the bearing and the bearing is destructed by thermal expansion of the bearing or a reduction in hardness thereof. In order to resolve the problem, there has been conceived a method of providing water passing paths 9 and 10 at vicinities of bearings 1, 2, 3 and 4 as shown by Fig. 7 and cooling the bearings 1, 2, 3 and 4 by making water flow. Fig. 7 exemplifies the vacuum pump having a pair of screws. The housing is constituted by a main casing 5 and bearing cases 16, 17 fixed to both end thereof. Numerals 6 and 7 designate rotors rotatably fixed to the housing via the bearings 1, 2, 3 and 4. An end portion of the rotor 6 is attached with a motor 8 for rotating the rotor 6. Further, the rotor 7 is rotated via timing gears 20 and 21 in synchronism with the rotor 6. An exhaust chamber 11 for exhausting a gas is provided to inside of the housing 5 containing the rotors 6 and 7, and respective shaft seals 12, 13, 14 and 15 are arranged at inside of the housing 5 containing the rotors 6 and 7 to seal the exhaust chamber and the bearings 1, 2, 3 and 4 filled with a lubricant such that inside of the exhaust chamber is not contaminated by oil.

[0003] However, in the case of such a vacuum pump having the rotating shaft of the background art, there poses a problem that by providing the paths for cooling water at vicinities of the bearings in order to cool the bearings to make cooling water flow, also the housing

is cooled and therefore, also heat at inside of the exhaust chamber maintained at a high temperature is deprived. It is necessary to maintain inside of the exhaust chamber at a high temperature in order to prevent the product from being adhered to the housing, the rotor or the like at inside of the exhaust chamber, in order to elevate the temperature at inside of the exhaust chamber while cooling the bearings, it is necessary to supply heat energy of a deprived heat amount or more to the housing by further heating to thereby pose also a problem of being caught in a vicious cycle of increasing also consumed energy. Further, in the case of the shaft structure having the shaft seals, there is a possibility of posing also a problem of destructing also the shaft seals by heat.

[0004] In view of the above-described problems, it is an object of the invention to provide a structure of preventing a bearing portion or a shaft seal portion from being destructed by elevating a temperature thereof even when a temperature of an exhaust chamber is elevated for a countermeasure against a product in exhausting a reactive gas in a vacuum pump having a drive portion of a bearing or the like.

Disclosure of the Invention

[0005] In order to resolve the above-described problem, according to the invention of Claim 1, the invention is characterized in a vacuum pump including introducing means having a vacuum exhaust chamber for exhausting a process gas into the vacuum exhaust chamber, exhausting means for exhausting the process gas to outside of the vacuum exhaust chamber, and a housing partitioning the vacuum exhaust chamber and outside wherein a rotor is rotatably fixed to inside of the housing via a bearing, and wherein insulating means is provided between the vacuum exhaust chamber and the bearing. Although the insulating means in a plate-like shape matched to a shape of an end face of the housing of the vacuum pump is easy to work and attach, when a heat generating amount is not so large, the insulating means can be partially arranged at a portion thereof proximate to the bearing.

[0006] Further, when a shaft seal comprising a material weak at heat is used, by arranging the shaft seal to a side of the bearing relative to the insulating means, the shaft seal can be protected against destruction by heat.

[0007] The invention of Claim 2 is characterized in that a material having a heat conductivity lower than a heat conductivity of a material of the housing is used as the insulating means. As the insulating means, a material which is solid to a degree of not being destructed even when the material is interposed between metals of a main casing, a bearing case and the like and having a significant insulating effect is suitable as the insulating means. There is a resin, a ceramic or the like as the insulating means.

[0008] According to the invention of Claim 3, the invention is characterized in that a resin having a heat conductivity lower than a heat conductivity of the housing and having a high corrosion resistance is used as the insulating means. As the insulating means, there is a fluorine species resin of Teflon (trade mark) as a material for being used for the insulating means which is solid to a degree of not being destructed even when the material is interposed between metals of a main casing, a bearing case and the like and easy to work and install.

[0009] According to the invention of Claim 4, the invention is characterized in that a hollow insulating member is used as the insulating means. A space of the hollow portion is hermetically sealed in vacuum or filled with a gas of atmosphere or the like, a liquid or a material having a low heat conductivity. Further, it is also effective for insulating to communicate the hollowed inside with the vacuum exhaust chamber to vacuum.

[0010] According to the invention of Claim 5, the invention is characterized in that a supporting member of the insulating means is provided at the insulating member arranged between a housing fixed with the bearing and a housing on a side of the vacuum exhaust chamber. In a case of using a soft material or a brittle material as the insulating means, the case can be resolved by preventing the insulating means from being exerted with a strong force from the housing by arranging the supporting member longer than the thickness of the insulating means between the housing member and the bearing case. For example, the case can be resolved by utilizing a hole of a bolt for fixing the housing member and the bearing case and the insulating means and inserting a support collar thicker than the thickness of the insulating means into the hole of the insulating means for passing the bolt.

[0011] According to the invention of Claim 6, the invention is characterized in that heat conducting means having a high heat conductivity is provided between the insulating means and the vacuum exhaust chamber. The high heat conductivity mentioned here signifies that the heat conductivity of the member is higher than that of the insulating material. It is preferable that the heat conductivity of the member is equal to or higher than the heat conductivity of the main casing forming the vacuum exhaust chamber. Further, the member having the high heat conductivity may be arranged to be brought into direct contact with the exhaust chamber as the end wall of the exhaust chamber.

[0012] According to the invention of Claim 7, the invention is characterized in that second insulating means is provided at an outer periphery of the housing. By constituting in this way, the exhaust chamber can completely be covered by the insulating members by constituting the first insulating means provided at an end portion of a rotating shaft of the rotor, that is, an end portion of the housing by a plate-like shape matched with the shape of the end portion and covering an outer peripheral portion of the main casing covering the outer periphery of

the rotor further by the second insulating means.

[0013] According to the invention of Claim 8, the invention is characterized in that heat conducting means is provided at the housing or/and an outer periphery of the housing. The heat conducting means can also be achieved by forming the heat conducting means by using a material having a high heat conductivity as the material of the housing.

[0014] According to the invention of Claim 9, the invention is characterized in that a heat pipe is used as the heat conducting means. As a method of arranging the heat pipe, there is a method of opening a hole in parallel with the rotating shaft at the housing and filling a working fluid, a method of opening a hole (groove) containing an existing heat pipe and inserting the existing heat pipe, or a method of fixedly attaching an existing heat pipe to a housing or the like.

[0015] According to the invention of Claim 10, the invention is characterized in that a metal having a high heat conductivity is used as the heat conducting means. There is a method of pasting a metal in a plate-like shape worked to be matched with the shape of the housing to an outer periphery of the housing, a method of forming a groove at a side face of the housing and fitting a metal to the groove, a method of opening a hole or a groove in an axial direction at inside of the housing and inserting a metal, a method of making a molten metal flow into a hole or a groove in an axial direction at inside of the housing or a method of previously arranging a metal having an excellent heat conductivity and a predetermined shape in a die to cast or the like. As the metal having the high heat conductivity, there are aluminum, gold, silver, copper, beryllium, brass and alloys of these and so on.

[0016] According to the invention of Claim 11, the invention is characterized in a vacuum pump including means for introducing a process gas into the vacuum exhaust chamber, exhausting means for exhausting the process gas to outside of the vacuum exhaust chamber, and a housing partitioning the vacuum exhaust chamber and outside, wherein a rotor is rotatably fixed to inside of the housing via a bearing, and wherein heat conducting means is provided at the housing or/and an outer periphery of the housing. Further, according to the invention of Claim 12, the invention is characterized in that a metal having a heat conductivity more excellent than a heat conductivity of a material of the housing is used as the heat conducting means. As the heat conducting means, there is a method of using a heat pipe, a method of using a metal having an excellent heat conductivity or the like. As a method of arranging a heat pipe, there is a method of forming a heat pipe directly at the housing by working the housing of a method of opening a hole in parallel with a rotating shaft at the housing and filling a working fluid, a method of opening a hole or a groove containing an existing heat pipe and inserting the existing heat pipe, a method of fixedly attaching an existing heat pipe to the housing by using a fixing member or the

like. The heat pipe may be constituted by a flat shape or a shape of a circular column. Further, as a method of pasting a metal, there is a method of pasting a metal in a plate-like shape constituted by pressing a metal having an excellent heat conductivity to be matched with a shape of the housing to an outer periphery of the housing, when the housing is a cast product and is provided with a warped surface, there is a method of flattening the surface to be pasted with a metal plate, coating an Si grease or the like having an excellent heat conductivity to paste, or pasting the Si grease by interposing a heat conductive sheet. Further, when a metal having a flexibility is used as the heat conductive sheet, there is a method constituted by promoting adherence between the housing and a metal by bringing the metal into press contact with the housing or by polishing the surface to be brought into press contact therewith. Otherwise, there may be used a method of forming a groove at a side face of the housing and fitting the metal into the groove, a method of opening a hole or a groove in an axial direction at inside of the housing and inserting the metal, a method of making a molten metal flow into a hole or a groove in an axial direction at inside of the housing or a method of previously arranging a metal having an excellent heat conductivity and a predetermined shape at inside of a die to cast or the like. Further, by forming a flat portion partially projected to a heat generating portion and a heat absorbing of the housing, and fixing the flat portion to bridge by a metal plate having an excellent heat conductivity, heat can be transferred from the heat generating portion to the heat absorbing portion of the housing. Further, by smoothing a surface of the flat portion partially projected to the heat generating portion and the heat absorbing portion for fixedly attaching the metal of the housing, thermal contact between the housing and the metal plate can easily be improved. As a metal having the excellent heat conductivity, there are aluminum, gold, silver, copper, beryllium, brass and alloys of these and so on.

Brief Description of the Drawings

[0017]

Fig.1 is a front sectional view of a vacuum pump of a first embodiment according to the invention.

Fig.2 is a side sectional view of a vacuum pump of a second embodiment according to the invention.

Fig.3 is a sectional view taken along a line A-A of Fig. 2 of the second embodiment according to the invention.

Fig. 4 is a sectional view orthogonal to a shaft of a vacuum pump of a third embodiment according to the invention.

Figs.5(a) and 5 (b) illustrates front sectional views of a bolt portion of a vacuum pump of a fourth embodiment according to the invention.

Fig.6 is a front sectional view of an upper bearing

portion of a vacuum pump of a fifth embodiment according to the invention.

Fig.7 is a front sectional view of a vacuum pump of a background art.

Best Mode for Carrying Out the Invention

[0018] An explanation will be given of embodiments of the invention in reference to the drawings as follows.

[0019] First, an explanation will be given of a constitution of a vacuum pump 100 according to Embodiment 1 of the invention in reference to Fig.1.

[0020] The vacuum pump 100 is provided with screw rotors 101 and 102.

[0021] The screw rotors 101 and 102 are contained in a rotor containing chamber formed at an inner portion of a housing. Describing in details, the screw rotor 101 is rotatably supported by the housing by bearings 104 and 105 and the screw rotor 102 is rotatably supported by the housing by bearings 106 and 107. Shaft seals 112, 113, 114 and 115 are respectively arranged between an exhaust chamber 111 and the bearings 104, 105, 106 and 107 filled with a lubricant for preventing the lubricant of the bearings 104, 105, 106 and 107 from being leaked to contaminate inside of the exhaust chamber by the lubricant and to prevent a foreign matter produced by a reactive gas from invading the bearings 104, 105, 106 and 107 from inside of the housing.

[0022] Further, end portions on one side of the screw rotor 101 and the screw rotor 102 are fixed with timing gears 109 and 110 for rotating other of the screw rotor 101 and the screw rotor 102 in accordance with rotation of one of the screw rotor 101 and the screw rotor 102 to be brought in mesh with each other respectively. Further, the one end portion of the screw rotor 102 is integrally connected with a motor 108.

[0023] The housing is opened with a suction port 103a for sucking a compressive fluid from outside of the housing to inside of the housing, the exhaust chamber 111 communicates with outside of the housing by the suction port 103a, and communicates with outside of the housing by an exhaust port 103e for exhausting the compressive fluid from inside of the housing to outside of the housing. Here, the suction port 103a communicates with a vacuumed vessel, not illustrated, and the exhaust port 103e communicates with an exhaust gas processing apparatus, not illustrated, or outside air.

[0024] The housing is formed from a suction side bearing case 121, an insulating member 122, a suction side end wall member 123, a main casing 124, an exhaust side end wall member 125, an insulating member 126, and an exhaust side bearing case 127. The suction bearing case 121 and the exhaust side bearing case 127 are installed with the bearings 104, 105, 106 and 107 for supporting a rotor. The insulating member 122 and the insulating member 126 are constituted by a material having a low heat conductivity and is fabricated by, for example, a stout heat resistant resin. The exhaust

chamber 111 for making a reactive gas flow is fabricated by the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 comprising a material having a heat conductivity higher than that of the insulating member 122 and the insulating member 126. By constituting the suction side end wall member 123, the main casing 124 and the exhaust side wall member 125 constituting the exhaust chamber by a material having the excellent heat conductivity in this way, heat generated by compressing an exhaust gas at a vicinity of the exhaust port 103e can be conducted to a total of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125, and there can be restrained a possibility of destructing the bearings 105 and 107, and the shaft seals 113 and 115 by heat by elevating the temperature only at a vicinity of the exhaust port 103e. Further, a temperature of a total of a housing face brought into contact with the exhaust chamber can be elevated and therefore, the product can be made to be difficult to be produced. Further, since the insulating member 122 and the insulating member 126 are constituted by an insulating material having a low heat conductivity, even when the suction side end wall member 123, the main casing 124 and the housing end wall member 125 need to be maintained at a high temperature, there can be restrained a possibility of destructing the bearings 105 and 107 and the shaft seals 113 and 115 by heat. Further, by covering outer peripheries of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 by an insulating member 128 comprising an insulating material, heat of the suction side end wall member 123, the main casing 124, and the exhaust side end wall member 125 can be restrained from being radiated to outside air, and the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 can be maintained at a high temperature. When the temperature of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 is not elevated to a degree of not producing the product, by mounting heating means 234 at a total or a portion of the suction side end wall member 123, the main casing 124, and the exhaust side end wall member 125, the suction end wall member 123, the main casing 124 and the exhaust side end wall member 125 can be maintained at a high temperature. As the heating means there is a method of covering the total of the outer periphery of the main casing 124 by a sheet-type heater, or attaching a heater to an arbitrary location of the suction side end wall member 123 or the main casing 124 (the suction side having the low temperature is optimum).

[0025] In this way, a vacuum pump which is difficult to produce the product can be constituted by maintaining inside of the exhaust chamber at a high temperature to a degree of not producing the product by heating the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 by heating

means when a reactive gas of a semiconductor process or the like is exhausted by the vacuum pump. Further, the temperature of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 can be made to be uniform by a method of embedding a heat pipe to inside of each housing or bringing a heat pipe into contact with a surface thereof in order to increase the heat conductivity of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125. Further, as other means, there is also a method of forming a groove at the housing and embedding a metal such as an alloy of copper having a very high heat conductivity to the groove, or opening a single or a plurality of holes or grooves at inside of the housing by using a drill and making a molten metal having an excellent heat conductivity flow thereto. Further, the heat conductivity of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 can further be increased by fixedly attaching a metal plate of copper or the like having a very high heat conductivity to surfaces of the suction end wall member 123, the main casing 124 and the exhaust side end wall member 125. By constituting in this way, all the portions in the exhaust chamber brought into contact with the gas can be maintained at a high temperature, almost all the gas can be delivered to outside of the pump as staying to be the gas, and there can be reduced a drawback that there is produced a location at a low temperature only at a portion of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125, the product is piled up there, a clearance necessary for rotating the rotor is not produced to increase a load, or the partially piled up product is detached to be bit between the rotors rotated reversely to each other and the rotors cannot be rotated, in the worst case, the rotors are exerted with unreasonable force by biting the product, and the rotors are destructed (broken).

[0026] Further, when a heat pipe or a metal having a very high heat conductivity is used as described above, heat can be made to be easily to conduct to the total of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 even in the case of using a material of the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 which is not provided with an excellent heat conductivity although the material is not corroded by a highly corrosive gas passing inside of the exhaust chamber.

[0027] Further, by forming water flow paths 230, 231 for making cooling water flow to peripheries of the suction side bearing case 121 and the exhaust side bearing 127 at vicinities of portions thereof for mounting the bearings, even when the temperature of the vicinity of the bearing or the shaft seal is elevated to be equal to or higher than a predetermined temperature, the bearing can be cooled by making water flow and therefore, an effect of preventing destruction by thermal expansion

can be enhanced. In this case, cooling water is made to be able to control the temperature of the bearing efficiently by controlling to make the cooling water flow or controlling a flow rate of making cooling water flow when the temperature is elevated to be higher than a previously determined temperature by temperature information of temperature sensors 232, 233 attached to the bearing portions. Further, it can be prevented that a temperature at inside of the exhaust chamber is lowered by depriving heat from the suction side end wall member 123, the main casing 124 and the exhaust side end wall member 125 by the suction side bearing case 121 and the exhaust side bearing case 127 cooled by presence of the housing insulating member 122 and the insulating member 126 which are the insulating means.

[0028] An explanation will be given of an embodiment of other uniformly heating means of the housing as a second embodiment in reference to Fig.2 and Fig.3. Fig. 2 shows a section in an axial direction of one screw rotor of a screw type vacuum pump having a pair of screw rotors. Further, Fig.3 is a sectional view taken along a line A-A of Fig.2. A screw rotor 251 is rotatably fixed at inside of a housing 253 via bearings 255 and 257. Numeral 267 designates a suction port, and numeral 269 designates an exhaust port. Numerals 259 and 261 designate insulating members for preventing the bearings 255 and 257 from being destructed by conducting heat at inside the exhaust chamber to vicinities of the bearings 255 and 257. Further, projected portions 263 and 265 are provided at the housing 253 for uniformly heating inside of the exhaust chamber, surfaces thereof are formed to be flat, and metal plates 271 and 273 comprising a metal having an excellent heat conductivity of pure copper, pure aluminum or the like are fixedly attached thereto by predetermined means to bridge the projected portions 263 and 265. Further, thermal contact between the metal plates 271 and 273 and the projected portions can be improved by making the flat portions of the projected portions 263 and 265 smooth. By constituting in this way, heat can be transferred from a side of the exhaust chamber the temperature of which is elevated by the housing of the vacuum pump to the suction side the temperature of which is not elevated so much and the housing can be heated uniformly.

[0029] An explanation will be given of other uniformly heating means as a third embodiment in reference to Fig.4. A basic structure of a vacuum pump is similar to that of Embodiment 2 and therefore, a sectional shape in correspondence with that of Fig.3 will be explained. Numerals 403 and 405 designate sections of screw rotors. Numeral 401 designates a housing 401 contained with the screws as a structure of uniformly heating the housing 401, the housing 401 is covered with a metal 407 having an excellent heat conductivity of an alloy of copper, aluminum or the like. The metal 407 can be formed by a method of fitting the metal 407 worked in a shape of a cylindrical housing, using the metal 407 worked to constitute a shape of the metal 407 when a

metal divided by a plural number is mounted to the housing 401, or casting the metal 407 further to the housing 401 which has already been finished.

[0030] Next, an explanation will be given of other fourth embodiment related to an insulating structure in reference to Figs.5(a) and 5(b).

[0031] A structure of a vacuum pump according to the embodiment is constituted quite similarly to that of the first embodiment and therefore, only an enlarged view showing a structure of insulating means is shown. Fig. 5(a) shows a case of using a hollow insulating member according to the embodiment. An insulating effect of a hollowed inside 301 is significant when the hollowed inside 301 is filled with a gas or a liquid having a low heat conductivity. Further, the insulating effect can further be promoted by hermetically closing the hollowed inside 301 of the hollowed insulating member in vacuum or constituting vacuum to a degree the same as that of the exhaust chamber by providing a hollow exhaust hole 302 communicating with the vacuumed exhaust chamber as shown by Fig.5(b).

[0032] According to the embodiment, the insulating effect can be achieved even by using a material having an excellent heat conductivity and therefore, there is not posed a problem which hampers high temperature uniform heat formation at inside of the exhaust chamber even when the material is used as the housing brought into contact with the exhaust chamber.

[0033] Further, although the rotor of the screw type is pointed out as an example in Figs.1, 2 and 3 of the above-described embodiments, the invention is naturally applicable to all of the vacuum pumps having a structure of being rotated by being supported by bearings of a Roots type constituting a section of a rotor by a cocoon shape, a claw type constituting a section of a rotor by a comma shaped bead or the like.

[0034] Further, an explanation will be given of a fifth embodiment in which when a soft material or a brittle material is used for insulating means, a supporting member longer than a thickness of the insulating means is arranged between the housing member and the bearing case arranged with the bearing to prevent a strong force by fastening from being exerted to the insulating means in reference to Fig.6. Numeral 601 designates a bearing case fixed with a bearing and a shaft seal, numeral 603 designates an insulating member using a soft material or a brittle material, and numerals 605 and 607 are housing members temperatures of which are elevated. Numeral 609 designates a holding member in a cylindrical shape comprising a material of a metal having a high hardness or ceramics through which a bolt 611 for integrally fixing the insulating means 603, and the housing members 605 and 607 is passed. Although the insulating member 609 having a length in an axial direction equal to or larger than a thickness of the insulating member 603 is optimum, the holding member 609 is not limited thereto when the insulating means comprises a material having flexibility. By constituting in this way,

when the bolt is fastened, the bearing case 601 and the housing member 605 can be prevented from exerting a strong force to the insulating member 603.

[0035] Further, there may be used a method of interposing a plurality of pins slightly longer than the insulating member between the bearing case 601 and the housing member 605 or a holding member in a ring-like shape matched to a shape of a housing covering the insulating means 603.

Industrial Applicability

[0036] As has been explained above, according to the invention of Claim 1, in the vacuum pump including the means having the vacuum exhaust chamber for introducing the process gas into the vacuum exhaust chamber, the exhausting means for exhausting the process gas to outside of the vacuum exhaust chamber, and the housing partitioning the vacuum exhaust chamber and the outside, wherein the rotor is rotatably fixed to inside of the housing via the bearing, by constructing the constitution of providing the insulating means between the vacuum exhaust chamber and the bearing portion, there can be prevented that heat generated by the heating means covering the housing or inside of the exhaust chamber is transferred in the housing to make the temperature of the bearing or the shaft seal formed in the housing elevate, or the temperature of the bearing or the shaft seal is elevated to destruct the member or destruct the member by thermally expansion.

[0037] According to the invention of Claim 2, by using the material having the heat conductivity lower than that of the material of the housing, insulating means having a significant insulating effect can be provided.

[0038] According to the invention of Claim 3, by using the resin having the heat conductivity lower than that of the material of the housing and having the corrosion resistance as the insulating means, the insulating means easily to work and install and having a significant insulating effect can be provided, further, even when the pump exhausts the highly corrosive gas, airtightness or strength can be prevented from being deteriorated by corroding the insulating material.

[0039] According to the invention of Claim 4, by constructing the constitution of using the hollow insulating material as the insulating means, the space of the hollow portion can be filled with a gas or a liquid having a low heat conductivity or inputted with the insulating member, which is effective for insulating.

[0040] According to the invention of Claim 5, by providing the supporting member of the insulating means at the insulating means arranged between the bearing case fixed with the bearing and the housing, a soft material can be used as the insulating means and choice of the insulating material can be enhanced.

[0041] According to the invention of Claim 6, by providing the heat conducting means at the housing or/and the outer periphery of the housing, even the temperature

at the vicinity of the insulating means at inside of the exhaust chamber can easily be elevated and the temperature at inside of the exhaust chamber can be made to be more uniform.

[0042] According to the invention of Claim 7, by constructing the constitution of providing the second insulating means at the outer periphery of the housing, the exhaust chamber can completely be covered with the insulating member, and even when the reactive gas is made to flow, the temperature at inside of the exhaust chamber can be maintained at a high temperature to a degree of not producing a reaction product.

[0043] According to the invention of Claim 8, by constructing the constitution of providing the heating conducting means at the housing or/and outer periphery of the housing, heat can be transferred from a portion of the outer periphery of the housing at a high temperature to a portion thereof at a low temperature and even when the reactive gas is made to flow, the temperature of the portion brought into contact with the exhaust chamber of the housing can be constituted by a uniform temperature by which the reaction product is made to be difficult to produce.

[0044] According to the invention of Claim 9, by constructing the constitution of using the heat pipe as the heat conducting means, the heat conductivity of the housing can considerably be increased.

[0045] According to the invention of Claim 10, by constructing the constitution of using the metal having the excellent heat conductivity as the heat conducting means, heat can easily be transferred by covering the housing by the metal which is easy to work.

[0046] According to the invention of Claim 11, in the vacuum pump including the means having the vacuum exhaust chamber for introducing the process gas into the vacuum exhaust chamber, the exhausting means for exhausting the process gas to outside of the vacuum exhaust chamber, and the housing partitioning the vacuum exhaust chamber and outside, in which the rotor is rotatably fixed to inside of the housing via the bearing, by providing the heat conducting means at the housing or/and the outer periphery of the housing, heat is delivered from the portion of the housing at a high temperature to a portion thereof at a low temperature and the temperature of the housing can be made to be uniform.

[0047] According to the invention of Claim 12, by using the metal having the heat conductivity more excellent than that of the material of the housing as heat conducting means, the heating conducting means can easily be worked.

Claims

1. A rotary vacuum pump **characterized in** a vacuum pump including introducing means having a vacuum exhaust chamber for introducing a process gas into the vacuum exhaust chamber, exhausting

means for exhausting the process gas to outside of the vacuum exhaust chamber, and a housing partitioning the vacuum exhaust chamber and outside wherein a rotor is rotatably fixed to inside of the housing via a bearing, and wherein insulating means is provided between the vacuum exhaust chamber and the bearing.

2. The rotary vacuum pump according to Claim 1, **characterized in that** a material having a heat conductivity lower than a heat conductivity of a material of the housing is used as the insulating means. 10
3. The rotary vacuum pump according to Claim 1, **characterized in that** a resin having a heat conductivity lower than a heat conductivity of the housing and having a high corrosion resistance is used as the insulating means. 15
4. The rotary vacuum pump according to Claim 1, 2 or 3, **characterized in that** a hollow insulating member is used as the insulating means. 20
5. The rotary vacuum pump according to Claim 1, 2, 3 or 4, **characterized in that** the housing is constituted by a bearing case provided with the bearing and a main casing at a surrounding of the rotor and a supporting member of the insulating means is provided between the bearing case and the main housing. 25
30
6. The rotary vacuum pump according to Claim 1, 2, 3, 4 or 5, **characterized in that** heat conducting means having a heat conductivity higher than a heat conductivity of a material of the insulating means is provided between the insulating means and the vacuum exhaust chamber. 35
7. The rotary vacuum pump according to Claim 1, 2, 3, 4, 5 or 6, **characterized in that** second insulating means is provided on a side of an atmosphere of an outer periphery of the housing. 40
8. The rotary vacuum pump according to Claim 1, 2, 3, 4, 5, 6 or 7, **characterized in that** heat conducting means is provided at the housing or/and an outer periphery of the housing. 45
9. The rotary vacuum pump according to Claim 8, **characterized in that** a heat pipe is used as the heat conducting means. 50
10. The rotary vacuum pump according to Claim 8, **characterized in that** a metal having a heat conductivity more excellent than the heat conductivity of the material of the housing is used as the heat conducting means. 55

11. A rotary vacuum pump **characterized in** a vacuum pump including introducing means having a vacuum exhaust chamber for introducing a process gas into the vacuum exhaust chamber, exhausting means for exhausting the process gas to outside of the vacuum exhaust chamber, and a housing partitioning the vacuum exhaust chamber and outside, wherein a rotor is rotatably fixed to inside of the housing via a bearing, and wherein heat conducting means is provided at an outer periphery of the housing or/and an outer periphery of the housing.

12. The rotary vacuum pump according to Claim 11, **characterized in that** a metal having a heat conductivity more excellent than a heat conductivity of a material of the housing is used as the heat conducting means.

FIG. 1

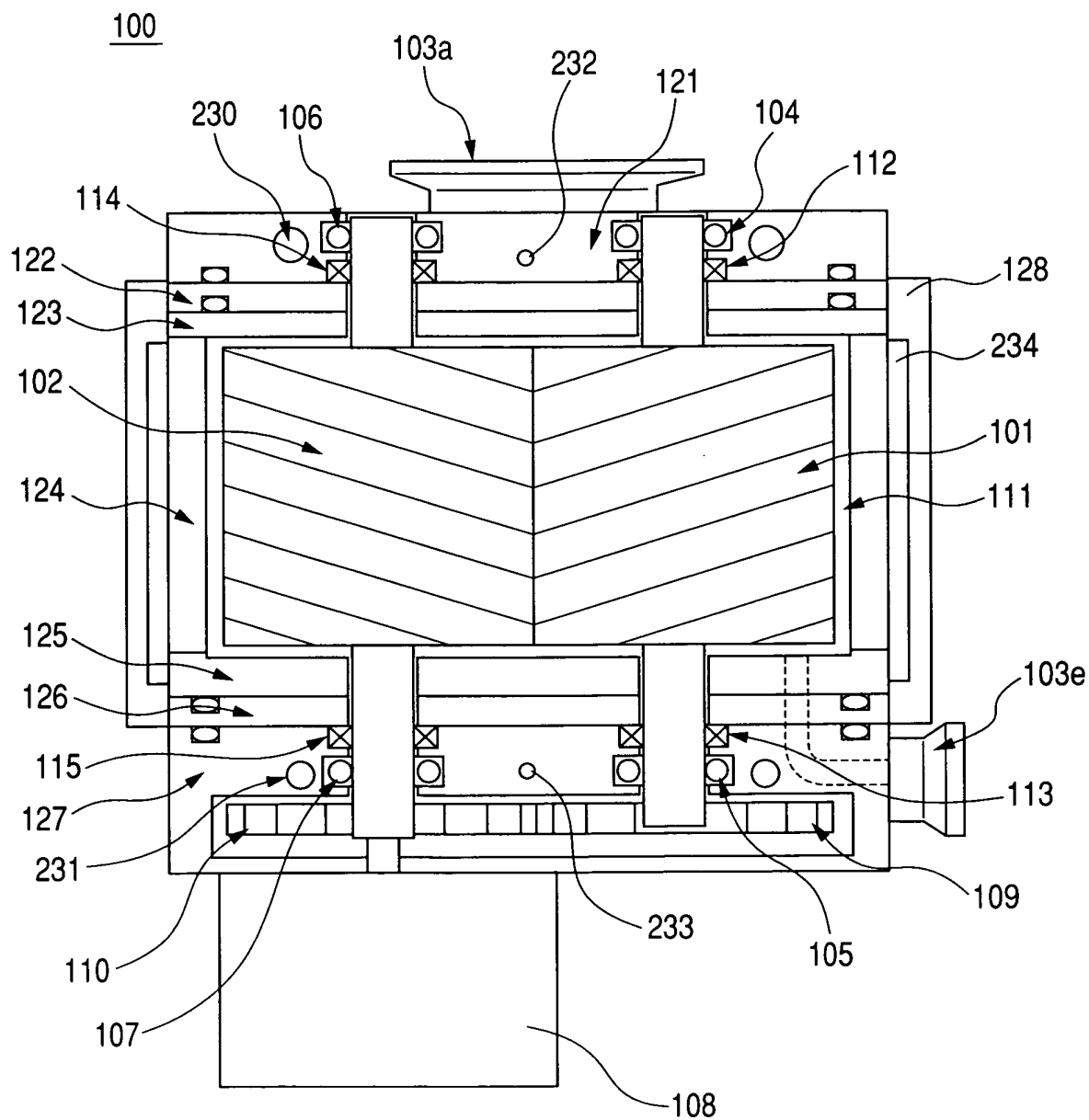


FIG. 2

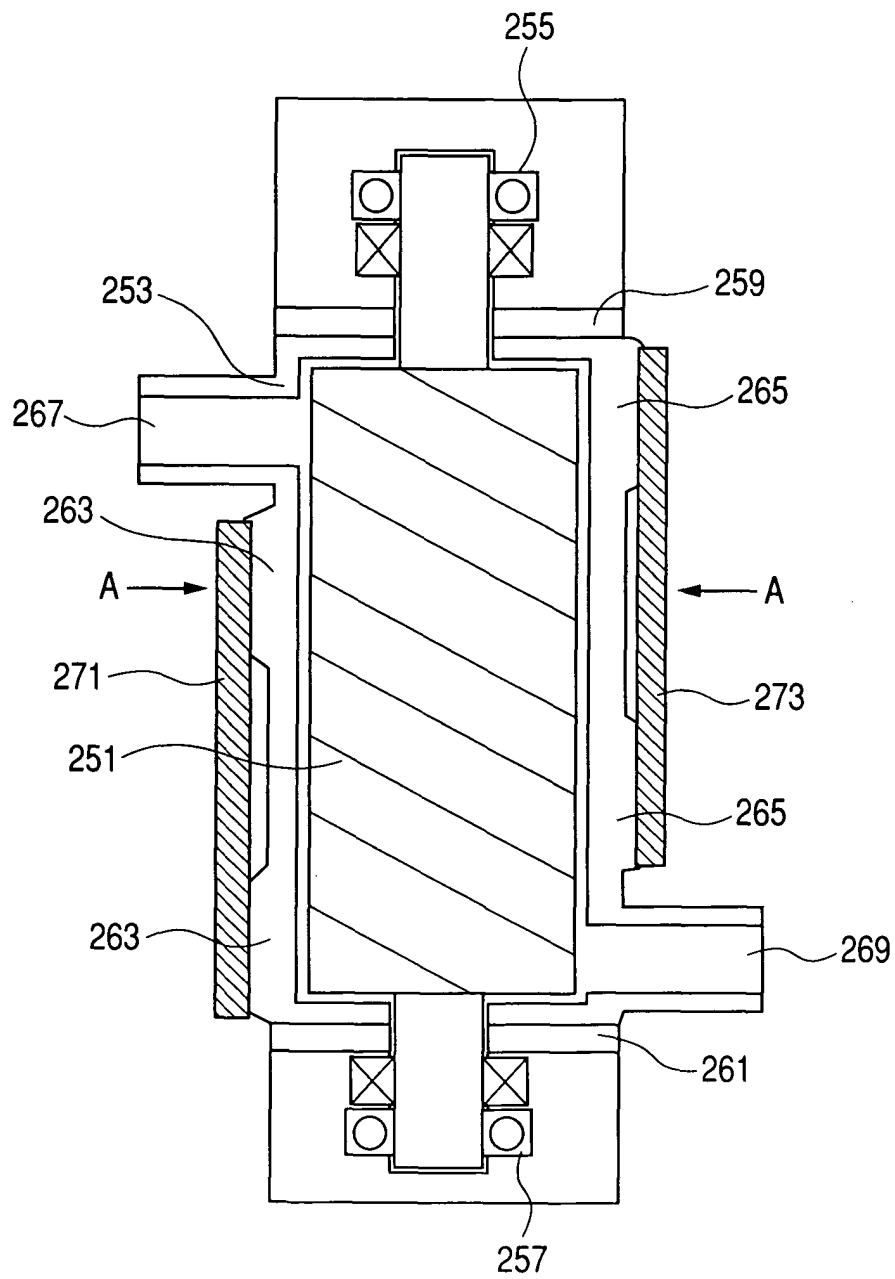


FIG. 3

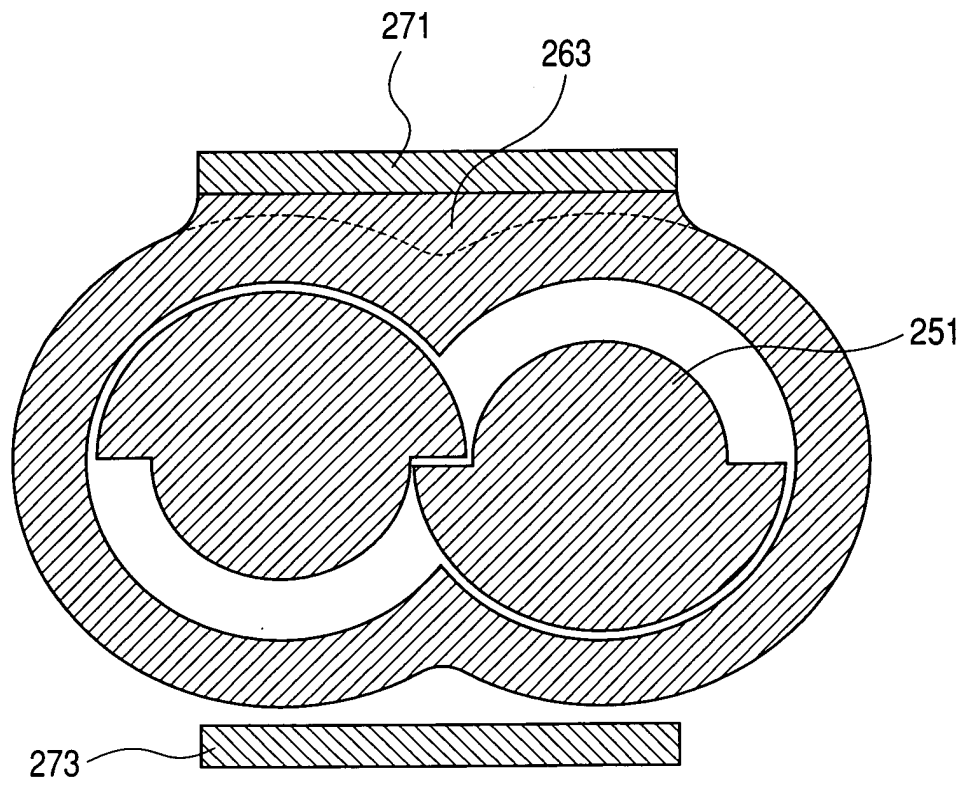


FIG. 4

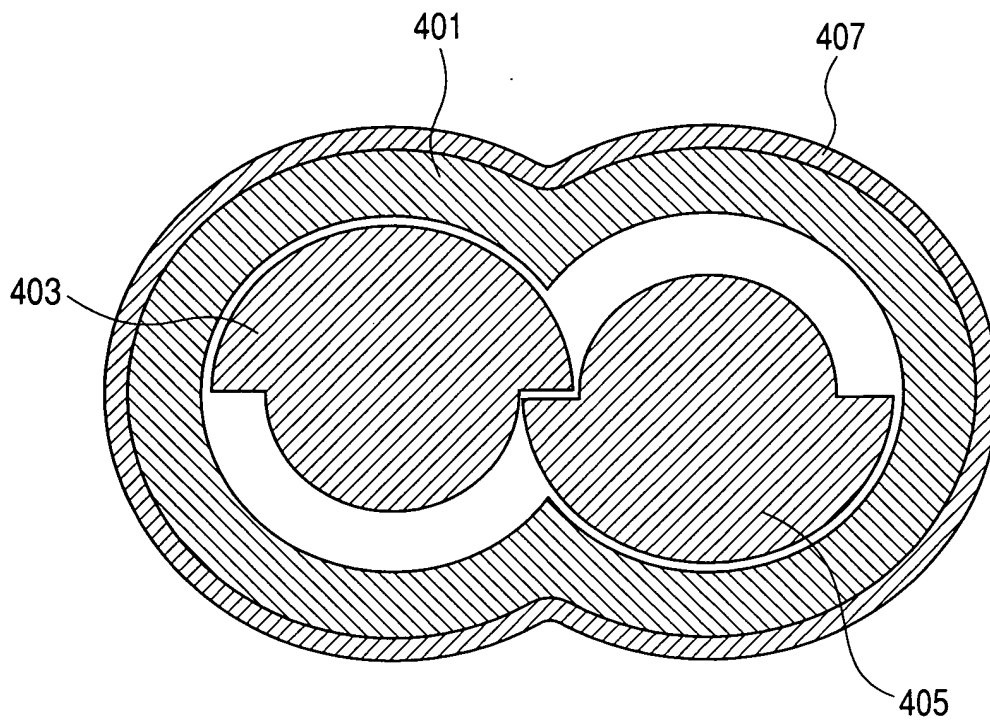


FIG. 5(a)

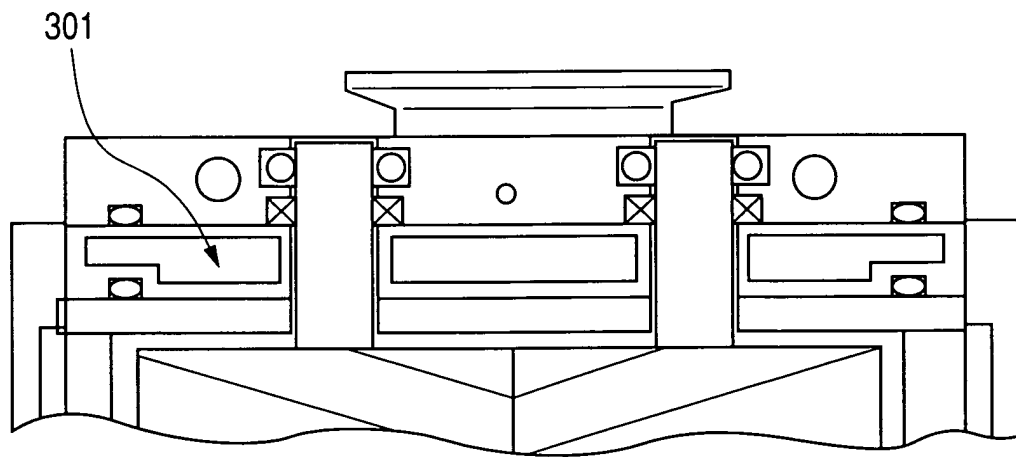


FIG. 5(b)

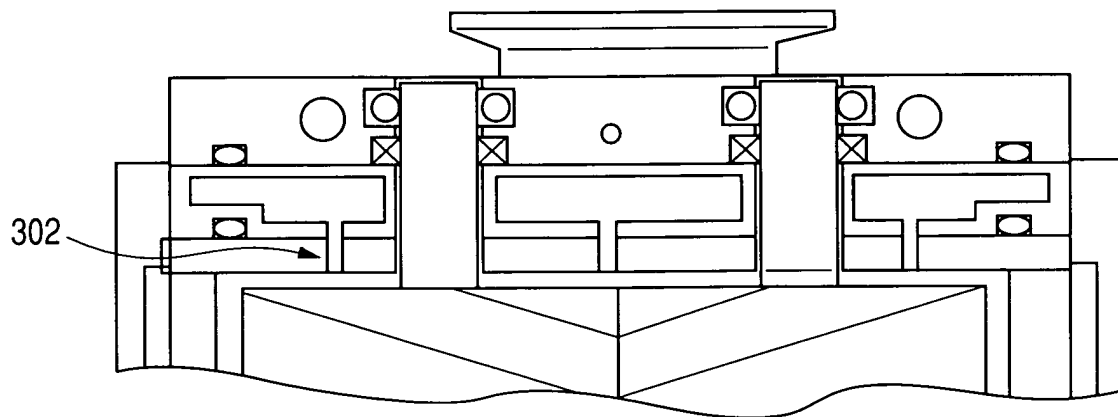


FIG. 6

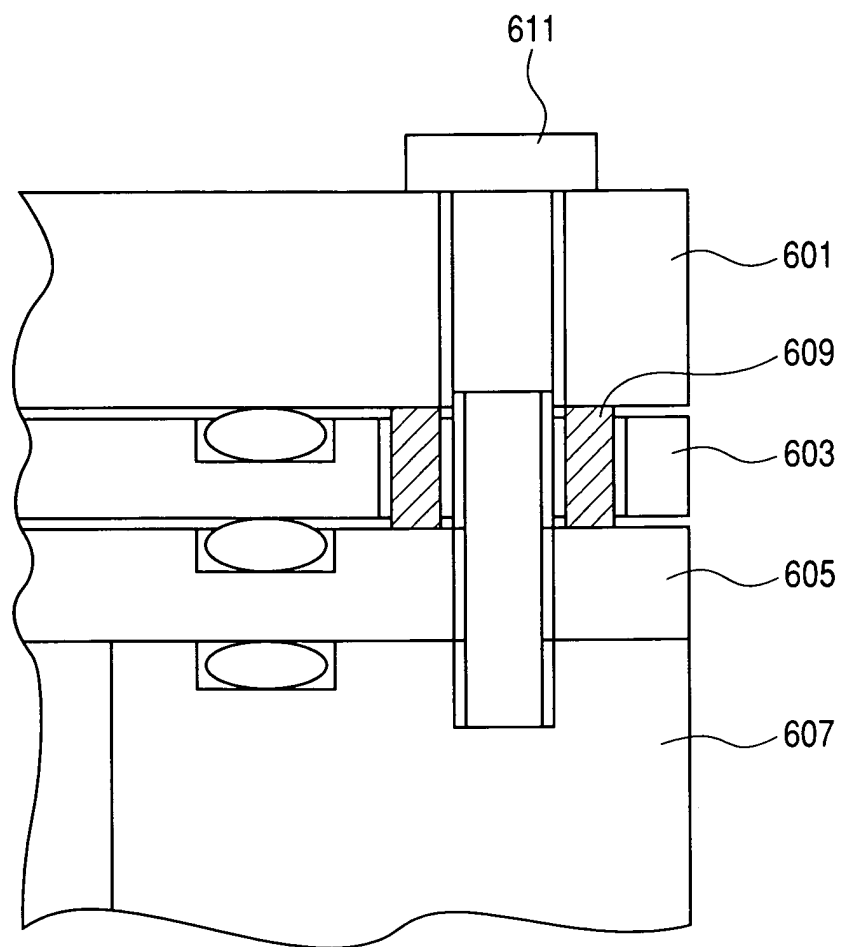
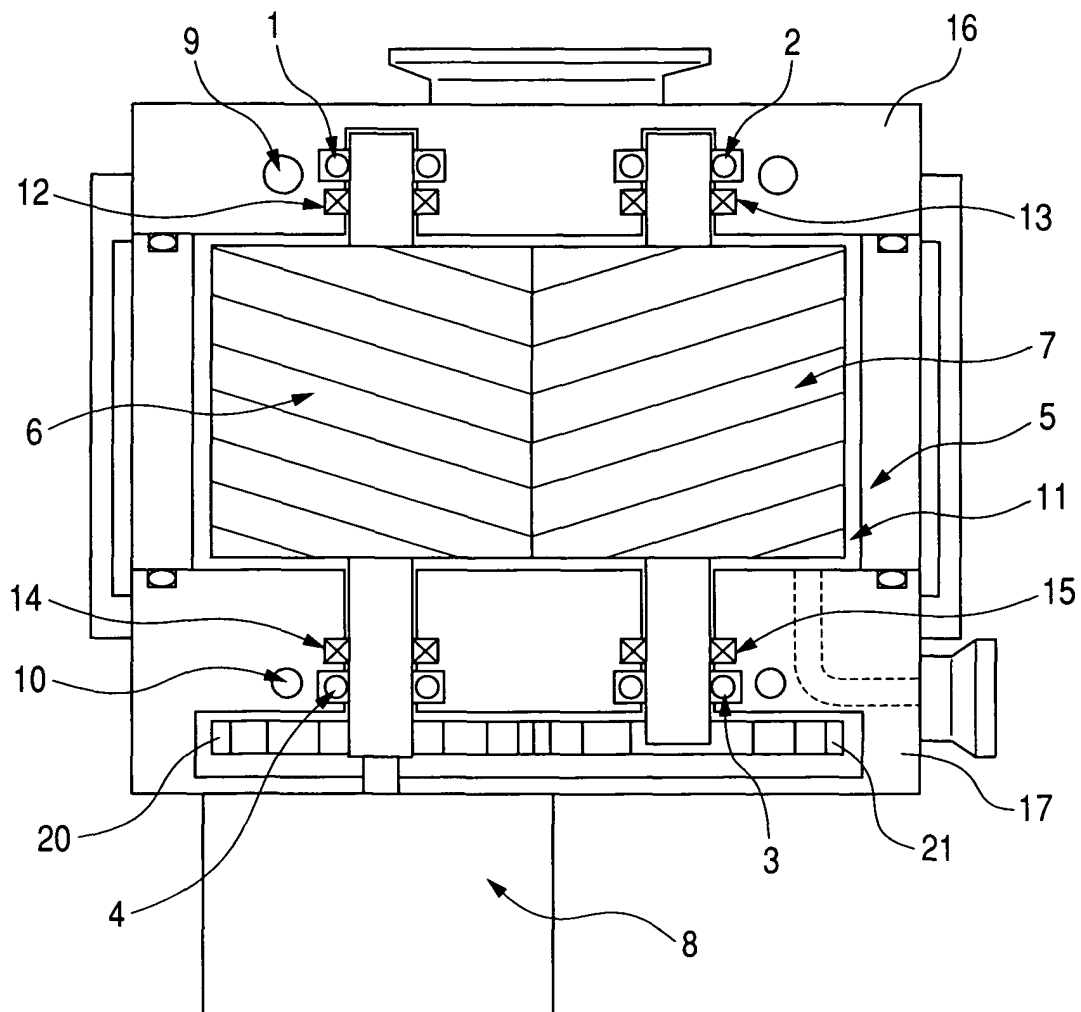


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/06260

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ F04C18/16, F04C29/00 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) Int.Cl ⁷ F04C18/16, F04C29/00 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Jitsuyo Shinan Toroku Koho 1996-2003 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2000-314386 A (Tochigi Fuji Sangyo Kabushiki Kaisha), 14 November, 2000 (14.11.00), Fig. 1 (Family: none)	1-5, 8-10 6
X Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 46752/1993 (Laid-open No. 17978/1995) (Shimadzu Corp.), 31 March, 1995 (31.03.95), Par. No. [0012] (Family: none)	1-5, 8-10 6
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* 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 document 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		
Date of the actual completion of the international search 30 July, 2003 (30.07.03)		Date of mailing of the international search report 12 August, 2003 (12.08.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/06260

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 11-315794 A (Kashiyama Kogyo Kabushiki Kaisha), 16 November, 1999 (16.11.99), Fig. 1 (Family: none)	11, 12 6
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 73063/1993 (Laid-open No. 38688/1995) (Orion Machinery Co., Ltd.), 14 July, 1995 (14.07.95), Full text (Family: none)	1-12
A	JP 7-91387 A (Matsushita Electric Industrial Co., Ltd.), 04 April, 1995 (04.04.95), Full text (Family: none)	1-12
A	JP 2-149791 A (Alcatel Cit), 08 June, 1990 (08.06.90), Full text & EP 362757 A	1-12

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