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(54) **VACUUM DEVICE AND VACUUM PUMP**

VAKUUMVORRICHTUNG UND VAKUUMPUMPE

DISPOSITIF SOUS VIDE ET POMPE SOUS VIDE

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Description

Technical Field

[0001] Relating to a vacuum apparatus and, in particular, relating to a vacuum apparatus for use in the semiconductor manufacturing field and so on and a vacuum pump for use in such a vacuum apparatus.

Background Art

[0002] Vacuum apparatuses have been used in the semiconductor manufacturing field and many other industrial fields. The vacuum apparatuses each generally comprise a vacuum chamber and a vacuum pump for keeping the inside of the vacuum chamber in a vacuum or pressure-reduced state.

[0003] The vacuum apparatus is disposed in a clean room and is configured to perform predetermined processing while introducing and exhausting a predetermined process gas into and from the vacuum chamber.

[0004] Referring to Fig. 1, description will be given of one example of a conventional vacuum apparatus employed in a semiconductor manufacturing system.

[0005] This vacuum apparatus comprises a plurality of reaction chambers (vacuum chambers) 10, 11, and 12, high vacuum pumps 1, 2, and 3 as first vacuum pumps one or a plurality of which are arranged for each of the reaction chambers 10, 11, and 12 in order to bring the inside thereof into a pressure-reduced or vacuum state, and booster pumps 4a, 5a, and 6a as second vacuum pumps and back pumps 4b, 5b, and 6b as third vacuum pumps that are arranged at subsequent stages of the high vacuum pumps, respectively.

[0006] Further, valves 22, 23, and 24 are provided between the high vacuum pumps 1, 2, and 3 and the booster pumps 4a, 5a, and 6a, respectively.

[0007] There are further provided load lock chambers 13 and 14 for transferring processing objects such as wafers to the reaction chambers 10, 11, and 12 and a transfer chamber 15 provided therein with a robot (transfer apparatus) that transfers the processing objects, brought into the load lock chamber 13, into the reaction chambers 10, 11, and 12 and transfers them from the reaction chambers 10, 11, and 12 into the load lock chamber 14.

[0008] A booster pump 8a and a back pump 8b are connected to the load lock chamber 13, a booster pump 7a and a back pump 7b are connected to the load lock chamber 14, and a booster pump 9a and a back pump 9b are connected to the transfer chamber 15, thereby being capable of bringing those chambers into pressure-reduced or vacuum states, respectively.

[0009] Further, although not illustrated, the reaction chambers 10, 11, and 12 are each provided with a gas inlet and heating means such as a heater to thereby carry out predetermined processing such as film formation while introducing a predetermined gas under heating.

[0010] In the figure, symbols A1 denote pipes between the high vacuum pumps 1, 2, and 3 and the booster pumps 4a, 5a, and 6a, respectively, while symbols A2 denote pipes between the reaction chambers 10, 11, and 12 and the high vacuum pumps 1, 2, and 3, respectively. Further, in the figure, symbol R denotes a clean room.

[0011] In the state where this vacuum apparatus is on standby, the transfer chamber 15 and the reaction chambers 10, 11, and 12 are each held in a pressure-reduced or vacuum state.

[0012] Then, a cassette with a plurality of processing objects such as wafers placed therein is brought into the load lock chamber 13 from the atmosphere outside the apparatus and the load lock chamber 13 is exhausted.

[0013] Subsequently, a gate valve (not illustrated) between the load lock chamber 13 and the transfer chamber 15 is opened and the processing object transfer robot uses its transfer arm to pick up one of the processing objects from the cassette and transfer it into the transfer chamber 15.

[0014] Thereafter, a gate valve (not illustrated) between the reaction chamber 10 and the transfer chamber 15 is opened and the processing object is placed on a stage in the reaction chamber 10 by the use of the transfer arm.

[0015] Then, after the predetermined processing such as film formation, the processed object is transferred into the other reaction chamber 11 or 12 or the load lock chamber 14 by the use of the transfer arm.

[0016] Then, after the processing, the processed object is finally transferred to the exterior from the load lock chamber 14.

[0017] In the conventional vacuum apparatuses including the system shown in Fig. 1, use is generally made, as the high vacuum pump, of a high vacuum pump that operates in the molecular area of ultimate vacuum (10^{-7} torr or less). Specifically, a turbomolecular pump or a thread groove pump is generally used as the high vacuum pump.

[0018] The turbomolecular pump and the thread groove pump each generally have a low allowable back pressure of 1 torr or less (specifically 0.5 torr or less and more specifically about 0.4 torr) while the pumping speed is high even with a small size. Therefore, there is/are provided, at the subsequent stage of the high vacuum pump, an intermediate/low vacuum pump or intermediate/low vacuum pumps in one or two stages which each operate at a relatively low back pressure while the ultimate vacuum is relatively low.

[0019] For example, in the case where vacuum pumps are provided in two stages at the subsequent stage of the high vacuum pump, a booster pump or the like is provided subsequent to the high vacuum pump as an intermediate vacuum pump and, further, a Roots pump or the like is provided subsequent to the booster pump as a low vacuum pump that operates at a relatively low back pressure while the ultimate vacuum is low.

[0020] A vacuum apparatus of this type having a plurality of stages of vacuum pumps for use in the semiconductor device manufacturing field is disclosed, for example, in Japanese Unexamined Patent Application Publication (JP-A) No. 2002-39061.

[0021] This object is solved by a vacuum pump having the technical features defined in patent claim 1.

[0022] A vacuum pump having the features defined in the preamble of claim is e.g. know from document JP 63-085292 A.

Disclosure of the Invention

[0023] As described above, in a vacuum apparatus for use in manufacturing semiconductor devices, use is generally made of two or three vacuum pumps, arranged in multistages in series with respect to one reaction chamber (vacuum chamber). These vacuum pumps often have mutually different structures as described above, but are all driven by electric motors. Accordingly, in the vacuum apparatus of this type where the number of vacuum pumps used is large, the power consumption increases. Since the power consumption of the vacuum apparatus resultantly affects the manufacturing cost of the semiconductor device, it is desired to reduce the power consumption.

[0024] Particularly, since the low vacuum pump (back pump) at the last stage among the multistage vacuum pumps is required to have a large capacity, the power consumption thereof is also large. Therefore, it is effective to suppress the power consumption of the back pump for a reduction in power consumption of the whole vacuum apparatus and thus a reduction in manufacturing cost of the semiconductor device, which is thus desirable.

[0025] Therefore, it is an object of this invention to provide a vacuum apparatus and a vacuum pump that can suppress the power consumption.

[0026] Further, according to this invention, there is obtained a vacuum pump, wherein the auxiliary pump is an ejector pump additionally attached to the discharge port of the vaccum pump .

[0027] Further, according to this invention, there is obtained the vacuum pump, wherein the ejector pump portion is incorporated in the vacuum pump.

[0028] Further, according to this invention, there is obtained the vacuum pump, wherein the vacuum pump is a dry pump, a screw pump or a Roots pump.

[0029] According to the vacuum apparatus or the vacuum pump of this invention, it is possible to suppress the power consumption of the vacuum pump as compared with conventional and, as a result, to reduce the manufacturing cost of a semiconductor device.

Brief Description of the Drawings

[0030]

Fig. 1 is a schematic diagram showing a vacuum apparatus for semiconductor manufacturing to be applied with this invention;

Fig. 2, (a) and (b) are sectional views showing a screw pump as a last-stage vacuum pump in a vacuum apparatus according to an embodiment 1 of this invention;

Fig. 3 is a sectional view showing an ejector pump in the vacuum apparatus according to the embodiment 1 of this invention;

Fig. 4, (a) and (b) are sectional views showing a screw pump as a last-stage vacuum pump in a vacuum apparatus according to an embodiment 2 of this invention; and

Fig. 5 is a diagram showing the relationship between inlet pressure and power consumption of the pump along with that of a comparative example for explaining the operation and effect of this invention.

Best Mode for Carrying Out the Invention

[0031] Hereinbelow, embodiments of this invention will be described with reference to the drawings.

[0032] A vacuum apparatus according to each embodiment of this invention is systemically the same as the vacuum apparatus shown in Fig. 1. Therefore, explanation about the same structure as that in Fig. 1 is omitted.

[0033] This invention particularly has a feature in the back pumps 4b, 5b, and 6b serving as the last-stage (third) vacuum pumps in Fig. 1. Specifically, the back pumps 4b, 5b, and 6b are each provided with an ejector pump that can mainly assist a pressure reducing operation by the back pump or suppress back diffusion from a discharge port, as will be described in detail later.

[Embodiment 1]

[0034] In the embodiment 1 of this invention, screw pumps A are used as the back pumps 4b, 5b, and 6b in Fig. 1, respectively.

[0035] Referring to Fig. 2, (a) and (b), a male rotor 25 and a female rotor 26 of the screw pump A are received in a main casing 42 and rotatably supported by bearings 35 and 36 attached to an end plate 43 sealing the main casing 42 on its one end side and bearings 37 and 38 attached to an auxiliary casing 46, respectively.

[0036] Timing gears 31 and 32 accommodated in the auxiliary casing 46 are mounted on rotation shafts 27 and 28 of the male and female rotors 25 and 26, respectively, and a gap between the male rotor 25 and the female rotor 26 is adjusted so that both rotors do not contact each other. Further, a motor M is attached to the rotation shaft of the male rotor 25 through a coupling or timing gear. It is configured that the rotation of the motor M is transmitted to the male rotor 25 and rotates the female rotor 26 through the timing gears 31 and 32.

[0037] An auxiliary casing 55 provided with an inlet port 56 is attached to the main casing 42 on its one end side. Further, the end plate 43 of the main casing 42 is formed with a discharge port 57 for discharging a gas compressed by the male rotor 25 and the female rotor 26.

[0038] Since the main casing 42, the compressed gas, and so on rise in temperature due to the compression of the gas, a cooling jacket 33 is formed on the outside of the main casing 42. A coolant such as water is caused to flow in the cooling jacket 33 to thereby cool the main casing 42, the compressed gas, and so on.

[0039] In the screw pump A thus configured, when the male rotor 25 is rotationally driven by the motor M, the female rotor 26 is rotationally driven through the timing gears 31 and 32. Then, following the rotation of the male rotor 25 and the female rotor 26, a gas from the corresponding one of the upper-stage booster pumps 4a, 5a, and 6a (Fig. 1) is sucked through the inlet port 56 into a working chamber formed by the male rotor 25, the female rotor 26, and the main casing 42. The sucked gas is discharged through the discharge port 57 while being compressed following the rotation of the male rotor 25 and the female rotor 26.

[0040] Herein, in this vacuum apparatus, there is provided an ejector pump 60 connected to the discharge port 57 of each screw pump A so as to suppress back diffusion through the discharge port 57 from the exterior at the atmospheric pressure. The ejector pump 60 is additionally attached to the discharge port 57 of the screw pump A as a component different from the screw pump A.

[0041] Referring also to Fig. 3, the ejector pump 60 comprises an inlet port 62, a gas inlet 63, a diffuser 64, and a discharge port 65.

[0042] During the operation of this vacuum apparatus, i.e. during the operation of the high vacuum pumps 1, 2, and 3, the booster pumps 4a, 5a, and 6a, and the back pumps 4b, 5b, and 6b (all in Fig. 1), an inert gas is constantly introduced from the gas inlet 63 toward the diffuser 61 of each ejector pump 60 under a pressure of 0.1MPa to 0.5MPa regardless of whether or not the gas is introduced into the reaction chambers 10, 11, and 12 (Fig. 1).

[0043] Consequently, according to the ejector pump principle, the pressure near the inlet port 62 and the discharge port 57 of the screw pump A becomes several 1000Pa to several 10000Pa. Since the ejector pump principle about generation of following flow, generation of shock wave in the diffuser, and so on is known, explanation thereof is omitted here.

[0044] As a result, the back diffusion heading toward the inlet port 56 of the screw pump A from the exterior at the atmospheric pressure through the discharge port 65 and the inlet port 62 of the ejector pump 60 and the discharge port 57 of the screw pump A is extremely reduced. Because of the suppression of the back diffusion, the high vacuum pumps 1, 2, and 3, the booster pumps 4a, 5a, and 6a, and the back pumps 4b, 5b, and 6b, particularly the back pumps 4b, 5b, and 6b, efficiently operate so that the power consumption thereof can be largely reduced. Further, because of the ejector pump 60, the back pressure (atmospheric pressure) at the discharge port 65 can be reduced to about 300 torr at the inlet port 62.

[0045] Fig. 5 shows the result of examining the relationship between the pressure at the inlet port 56 of the screw pump A and the power consumption of the screw pump A when the screw pumps A were applied as the back pumps 4b, 5b, and 6b in the vacuum apparatus shown in Fig. 1. In this examination, pumps each having the same structure as the screw pump A except having no ejector pump were applied as the back pumps 4b, 5b, and 6b in the vacuum apparatus of Fig. 1 as a comparative example and the same measurement was carried out.

[0046] As clear from Fig. 5, with respect to the screw pump A having the ejector pump 60, the power consumption is low overall regardless of the value of the inlet pressure as compared with the screw pump having no ejector pump. Particularly, when the inlet pressure is less than 10 torr, the power consumption of the screw pump A having the ejector pump 60 is reduced by approximately 50% as compared with that of the screw pump having no ejector pump.

[0047] In other words, in the case where the screw pumps A are applied as the back pumps 4b, 5b, and 6b of the vacuum apparatus shown in Fig. 1, it can be said that a higher effect is achieved when no gas is introduced into the reaction chambers 10, 11, and 12 (Fig. 1).

[Embodiment 2]

[0048] In the embodiment 2 of this invention, screw pumps B are used as the back pumps 4b, 5b, and 6b in Fig. 1, respectively.

[0049] Referring to Fig. 4, (a) and (b), in the screw pump B, like in the screw pump A shown in Fig. 2, (a) and (b), a male rotor 25 and a female rotor 26 are received in a main casing 42 and rotatably supported by bearings 35 and 36 attached to an end plate 43 sealing the main casing 42 on its one end side and bearings 37 and 38 attached to an auxiliary casing 46, respectively.

[0050] Timing gears 31 and 32 accommodated in the auxiliary casing 46 are mounted on rotation shafts 27 and 28 of the male and female rotors 25 and 26, respectively, and a gap between the male rotor 25 and the female rotor 26 is adjusted so that both rotors do not contact each other. Further, a motor M is attached to the rotation shaft of the male rotor 25 through a coupling or timing gear. It is configured that the rotation of the motor M is transmitted to the male rotor 25 and rotates the female rotor 26 through the timing gears 31 and 32.

[0051] An auxiliary casing 55 provided with an inlet port 56 is attached to the main casing 42 on its one end side. Further, the end plate 43 of the main casing 42 is formed with a discharge port 57 for discharging a gas compressed by the male rotor 25 and the female rotor 26.

[0052] Since the main casing 42, the compressed gas, and so on rise in temperature due to the compression of the gas, a cooling jacket 33 is formed on the outside of the main casing 42. A coolant such as water is caused to flow in the cooling jacket 33 to thereby cool the main casing 42, the compressed gas, and so on.

[0053] In the screw pump B thus configured, when the male rotor 25 is rotationally driven by the motor M, the female rotor 26 is rotationally driven through the timing gears 31 and 32. Then, following the rotation of the male rotor 25 and the female rotor 26, a gas from the corresponding one of the upper-stage booster pumps 4a, 5a, and 6a (Fig. 1) is sucked through the inlet port 56 into a working chamber formed by the male rotor 25, the female rotor 26, and the main casing 42. The sucked gas is discharged through the discharge port 57 while being compressed following the rotation of the male rotor 25 and the female rotor 26.

[0054] In this embodiment, each screw pump B is incorporated with an ejector pump portion 60 connected to the discharge port 57 so as to suppress back diffusion through the discharge port 57 from the exterior at the atmospheric pressure. That is, the ejector pump portion 60 is incorporated at the discharge port 57 portion in the end plate 43 of the screw pump B as a component integral with the screw pump B.

[0055] The ejector pump portion 60 comprises an inlet port 62, a gas inlet 63, a diffuser 64, and a discharge port 65.

[0056] During the operation of this vacuum apparatus, i.e. during the operation of the high vacuum pumps 1, 2, and 3, the booster pumps 4a, 5a, and 6a, and the back pumps 4b, 5b, and 6b (all in Fig. 1), an inert gas is constantly introduced from the gas inlet 63 toward the diffuser 61 of each ejector pump portion 60 under a pressure of 0.1MPa to 0.5MPa regardless of whether or not the gas is introduced into the reaction chambers 10, 11, and 12 (Fig. 1).

[0057] Consequently, according to the ejector pump principle, the pressure near the inlet port 62 and the discharge port 57 of the screw pump B becomes several 1000Pa to several 10000Pa.

[0058] As a result, the back diffusion heading toward the inlet port 56 of the screw pump B from the exterior at the atmospheric pressure through the discharge port 65 and the inlet port 62 of the ejector pump portion 60 and the discharge port 57 of the screw pump B is extremely reduced. Because of the suppression of the back diffusion, the high vacuum pumps 1, 2, and 3, the booster pumps 4a, 5a, and 6a, and the back pumps 4b, 5b, and 6b, particularly the back pumps 4b, 5b, and 6b, efficiently operate so that the power consumption thereof can be largely reduced.

[0059] Even when the screw pumps B according to this embodiment were applied as the back pumps 4b, 5b, and 6b in the vacuum apparatus shown in Fig. 1, the result shown in Fig. 5 was obtained like in the embodiment 1.

[0060] As clear from Fig. 5, with respect to the screw pump B having the ejector pump portion 60, the power consumption is low overall regardless of the value of the inlet pressure as compared with the screw pump having no ejector pump. Particularly, when the inlet pressure is less than 10 torr, the power consumption of the screw pump B having the ejector pump portion 60 is reduced by approximately 50% as compared with that of the screw pump having no ejector pump.

[0061] In other words, in the case where the screw pumps B are applied as the back pumps 4b, 5b, and 6b of the vacuum apparatus shown in Fig. 1, it can be said that a higher effect is achieved when no gas is introduced into the reaction chambers 10, 11, and 12 (Fig. 1).

[0062] Since the screw pump according to this embodiment is incorporated with the ejector pump portion, it is compact as compared with the screw pump externally mounted with the ejector pump like in the embodiment 1. Accordingly, when applied to a vacuum apparatus having a plurality of back pumps, it is possible to reduce the occupying space of the whole vacuum apparatus.

[0063] In the foregoing embodiments, the screw pump is cited as the example of the back pump. However, the vacuum pump according to this invention that is attached with or incorporated with the ejector pump may be a Roots pump or the like.

[0064] Further, the vacuum pump according to this invention is not limited to the back pump in the multistage structure but can be used as a vacuum pump in a single-stage structure as long as the back pressure thereof is within a pressure area over which the effect of the ejector pump appears. Moreover, the use thereof is not limited to the vacuum apparatus for manufacturing semiconductor devices.

Industrial Applicability

[0065] A vacuum pump according to this invention is not limited to a back pump in a multistage structure but can be used as a vacuum pump in a single-stage structure as long as the back pressure thereof is within a pressure area over which the effect of an ejector pump appears. Further, a use thereof is not limited to a vacuum apparatus for manufacturing semiconductor devices.

Claims

1. A vacuum pump (A, B) used in vacuum apparatus, wherein the vacuum apparatus comprises a vacuum chamber (10) having a gas inlet and a gas outlet and mechanical vacuum pumps in a plurality of stages (1, 4a, 4b) connected to said vacuum chamber (10), said mechanical vacuum pumps (1, 4a, 4b) reduce a pressure inside said vacuum chamber and maintain a pressure-reduced state;
wherein said vacuum pump (A, B) serves as the vacuum pump at the last stage (4b) of said mechanical vacuum pumps (1, 4a, 4b) and comprises a discharge port (57) and a non-mechanical auxiliary pump (60) connected to said discharge port (57);
wherein said auxiliary pump (60) assists a pressure reducing operation of said vacuum pump (A, B) and suppresses back diffusion from said discharge port

(57) ;
wherein said auxiliary pump (60) is directly connected to said discharge port (57) and is integrated with said vacuum pump (A, B);
wherein said auxiliary pump (60) comprises an auxiliary gas inlet (63) formed one end of said auxiliary pump (60), an auxiliary discharge port (65) formed the other end of said auxiliary pump (60), a diffuser (64) formed between said auxiliary gas inlet (63) and said auxiliary discharge port (65), and an auxiliary inlet port (62) formed between said auxiliary gas inlet (63) and said diffuser (64) and directly connected to said discharge port (57) of said vacuum pump at the last stage (A, B);
characterized in that an inert gas is constantly introduced from said auxiliary gas inlet (63) toward said diffuser (64) of said auxiliary pump (60) under a pressure of 0.1MPa to 0.5MPa.

2. A vacuum pump (A) according to claim 1, wherein said auxiliary pump (60) is an ejector pump additionally attached to said discharge port (57) of said vacuum pump (A).

3. A vacuum pump (B) according to claim 1, wherein said auxiliary pump (60) is an ejector pump incorporated in said vacuum pump (B).

4. A vacuum pump (A, B) according to any one of claims 1 to 3, wherein said vacuum pump (A, B) is a dry pump.

5. A vacuum pump (A, B) according to claim 4, wherein said vacuum pump (A, B) is a screw pump or a Roots pump.

6. A vacuum apparatus comprising said vacuum pump (A, B) according to any one of claims 1 to 5, said vacuum chamber (10), and said vacuum pumps (1, 4a, 4b).

7. A vacuum apparatus according to claim 6, wherein said vacuum pumps are structured by a first vacuum pump (1) for maintaining the inside of said vacuum chamber (10) to be reduced in pressure, a second vacuum pump (4a) connected at a subsequent stage of said first vacuum pump (1), and a third vacuum pump connected at a subsequent stage of said second vacuum pump (4a), said third vacuum pump serving as said pump at the last stage (4b);
wherein said first vacuum pump (1) is a turbomolecular pump or a thread groove pump; and
wherein said second vacuum pump (4a) is a booster pump.

Patentansprüche

1. Vakuumpumpe (A, B,) die in einer Vakuumvorrichtung verwendet wird, wobei die Vakuumvorrichtung aufweist: eine Vakuumkammer (10) mit einem Gaseinlass und einem Gasauslass und mechanische Vakuumpumpen in einer Anzahl von Stufen (1, 4a, 4b), die mit der Vakuumkammer (10) verbunden sind, wobei die mechanischen Vakuumpumpen (1, 4a, 4b) einen Druck im Inneren der Vakuumkammer reduzieren und einen druckreduzierten Zustand aufrechterhalten;
wobei die Vakuumpumpe (A, B) als die Vakuumpumpe in der letzten Stufe (4b) der mechanischen Vakuumpumpen (1, 4a, 4b) dient und eine Ausgabeöffnung (57) und eine nicht-mechanische Hilfspumpe (60) aufweist, die mit der Ausgabeöffnung (57) verbunden ist;
wobei die Hilfspumpe (60) zu dem druckreduzierenden Betrieb der Vakuumpumpe (A, B) beiträgt und die Rückdiffusion von der Ausgabeöffnung (57) unterdrückt;
wobei die Hilfspumpe (60) direkt mit der Ausgabeöffnung (57) verbunden ist, und in der Vakuumpumpe (A, B) integriert ist;
wobei die Hilfspumpe (60) einen Hilfsgaseingang (63) aufweist, der an einem Ende der Hilfspumpe (60) ausgebildet ist, wobei an dem anderen Ende der Hilfspumpe (60) eine Hilfsausgabeöffnung (65) ausgebildet ist, zwischen dem Hilfsgaseingang (63) und der Hilfsausgabeöffnung (65) ein Luftverteiler (64) ausgebildet ist, und zwischen dem Hilfsgaseingang (63) und dem Luftverteiler (64) eine Hilfseingangsöffnung (62) ausgebildet ist und direkt mit der Ausgabeöffnung (57) der Vakuumpumpe an der letzten Stufe (A, B) verbunden ist;
dadurch gekennzeichnet, dass ein Inertgas konstant von dem Hilfsgaseingang (63) in Richtung auf den Luftverteiler (64) der Hilfspumpe (60) unter einem Druck von 0,1 MPa - 0,5 MPa eingeleitet wird.

2. Vakuumpumpe A nach Anspruch 1, wobei die Hilfspumpe (60) eine Saugstrahlpumpe ist, die zusätzlich an der Ausgabeöffnung (57) der Vakuumpumpe (A) befestigt ist.

3. Vakuumpumpe (B) nach Anspruch 1, wobei die Hilfspumpe (60) eine Saugstrahlpumpe ist, die in der Vakuumpumpe (B) eingebaut ist.

4. Vakuumpumpe (A, B) nach einem der Ansprüche 1 bis 3, wobei die Vakuumpumpe (A, B) eine Trockenpumpe ist.

5. Vakuumpumpe (A, B) nach Anspruch 4, wobei die Vakuumpumpe (A, B) eine Schneckenpumpe oder eine Rootspumpe ist.

6. Vakuumvorrichtung, die die Vakuumpumpe (A, B) gemäß einem der Ansprüche 1 bis 5, die Vakuumkammer (10) und die Vakuumpumpen (1, 4a, 4b) enthält.

7. Vakuumvorrichtung nach Anspruch 6, wobei die Vakuumpumpen durch eine erste Vakuumpumpe (1), um das Reduzieren des Druckes im Inneren der Vakuumkammer (10) aufrechtzuerhalten, eine zweite Vakuumpumpe (4a), die an der darauffolgenden Stufe der ersten Vakuumpumpe (1) angeschlossen ist, und eine dritte Vakuumpumpe, die an einer darauffolgenden Stufe der zweiten Vakuumpumpe (4a) angeschlossen ist, gebaut ist, wobei die dritte Vakuumpumpe als die Pumpe an der letzten Stufe (4b) dient;
wobei die erste Vakuumpumpe (1) eine Turbomolekularpumpe oder eine Schneckennutenpumpe ist; und
wobei die zweite Vakuumpumpe (4a) eine Boosterpumpe ist.

Revendications

1. Pompe à vide (A, B) utilisée dans un appareil de vide comportant une chambre à vide (10) ayant une entrée de gaz et une sortie de gaz ainsi que des pompes à vide, mécaniques dans plusieurs étages (1, 4a, 4b) reliés à la chambre à vide (10), les pompes à vide mécaniques (1, 4a, 4b) réduisant la pression dans la chambre à vide et y maintenant un état de pression réduit,
la pompe à vide (A, B) sert de pompe à vide du dernier étage (4b) des pompes à vide mécaniques (1, 4a, 4b) et elle comporte un orifice d'évacuation (57) auquel est reliée une pompe auxiliaire non mécanique (60),
la pompe auxiliaire (60) participe à l'opération de réduction de pression de la pompe à vide (A, B) et supprime la diffusion en retour de l'orifice d'évacuation (57),
la pompe auxiliaire (60) est directement reliée à l'orifice d'évacuation (57) et elle est intégrée dans la pompe à vide (A, B), et
la pompe auxiliaire (60) comporte une entrée de gaz auxiliaire (63) à une extrémité de la pompe auxiliaire (60), un orifice d'évacuation auxiliaire (65) à l'autre extrémité de la pompe auxiliaire (60), un diffuseur (64) entre l'entrée de gaz auxiliaire (63) et l'orifice auxiliaire d'évacuation (65) ainsi qu'un orifice d'entrée auxiliaire (62) formé entre l'entrée auxiliaire de gaz (63) et le diffuseur (64) en étant relié directement à l'orifice d'évacuation (57) de la pompe à vide du dernier étage (A, B),
caractérisé en ce qu'
un gaz inerte est introduit de façon constante par l'entrée de gaz auxiliaire (63) vers le diffuseur (64) de la pompe auxiliaire (60) sous une pression de 0,1 MPa à 0,5 MPa.

2. Pompe à vide (A) selon la revendication 1,
dans laquelle
la pompe auxiliaire (60) est une pompe à éjecteur reliée en plus à l'orifice d'évacuation (57) de la pompe à vide (A).

3. Pompe à vide (B) selon la revendication 1,
dans laquelle
la pompe auxiliaire (60) est une pompe à éjecteur intégrée dans la pompe à vide (B).

4. Pompe à vide (A, B) selon l'une des revendications 1 à 3,
dans laquelle
la pompe à vide (A, B) est une pompe sèche.

5. Pompe à vide (A, B) selon la revendication 4,
dans laquelle
la pompe à vide (A, B) est une pompe à vis ou une pompe Roots.

6. Appareil de vide comportant la pompe à vide (A, B) selon l'une des revendications 1 à 5,
comprenant la chambre à vide (10) et les pompes à vide (1, 4a, 4b).

7. Appareil de vide selon la revendication 6,
dans lequel
les pompes à vide sont structurées par une première pompe à vide (1) pour maintenir l'intérieur de la chambre à vide (10) à une pression réduite, une seconde pompe à vide (4a) reliée à l'étage suivant de la première pompe à vide (1) et une troisième pompe à vide reliée à l'étage suivant de la seconde pompe à vide (4a), la troisième pompe à vide servant de pompe pour le dernier étage (4b),
la première pompe à vide (1) est une pompe turbomolléculaire ou une pompe à vis, et
la seconde pompe à vide (4a) est une pompe de gavage.

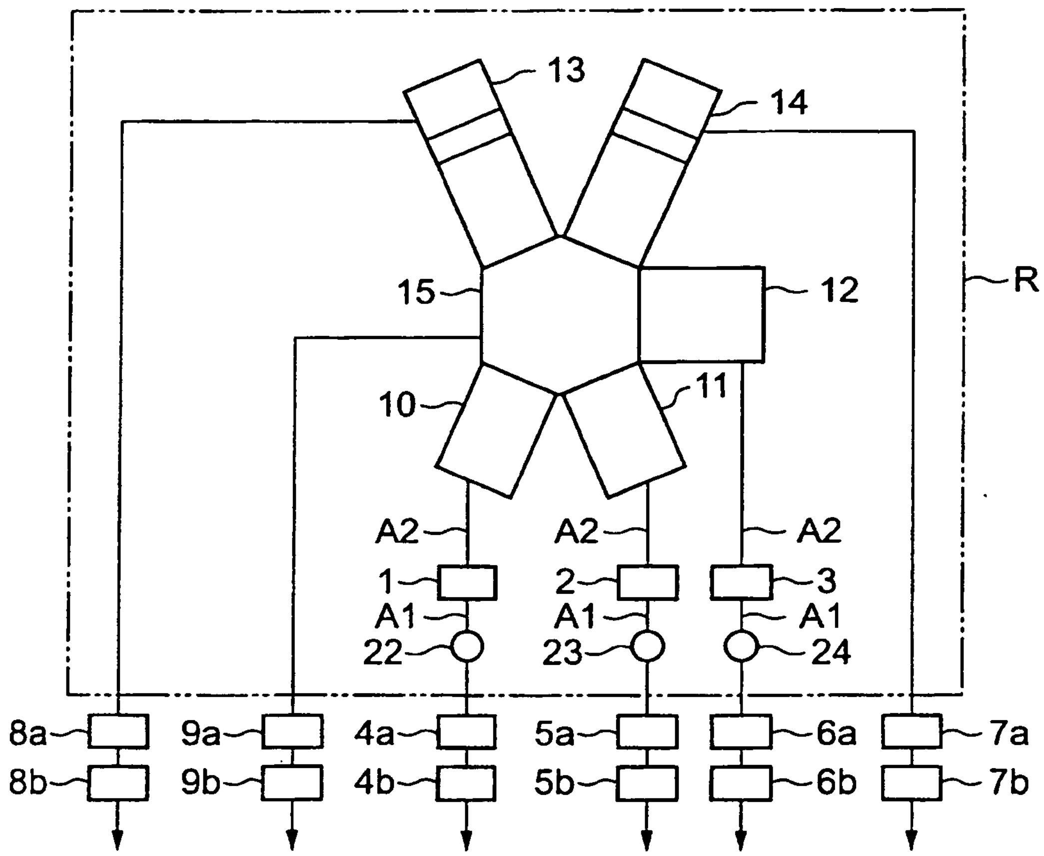

13
14
R
15
12
10
11
A2
A2
A2
1
2
3
A1
A1
A1
22
23
24
8a
9a
4a
5a
6a
7a
8b
9b
4b
5b
6b
7b

FIG. 1

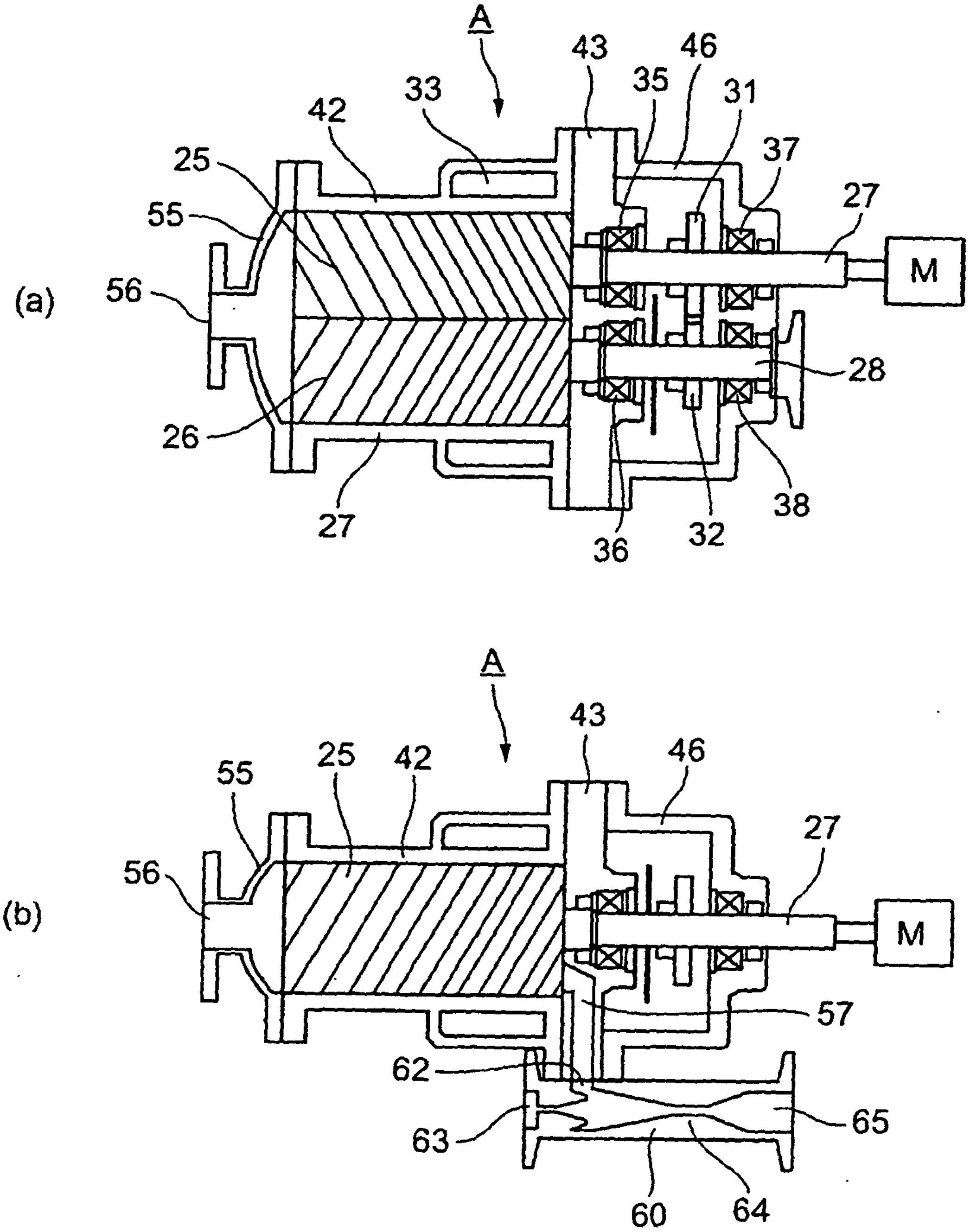

A
43
46
35
31
33
42
37
25
27
55
M
(a)
56
28
26
38
27
32
36
A
43
46
55
25
42
27
56
M
(b)
57
62
63
65
60
64

FIG. 2

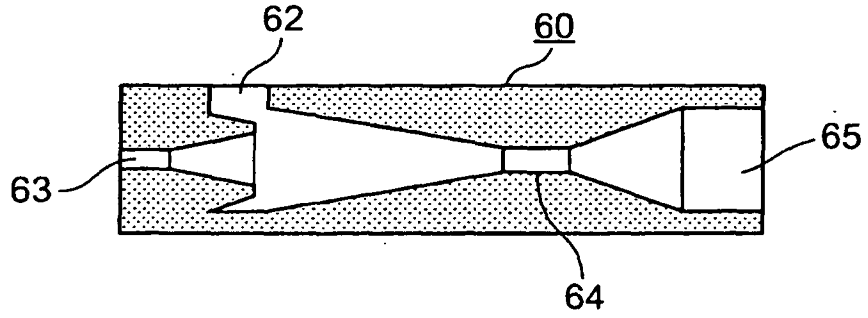
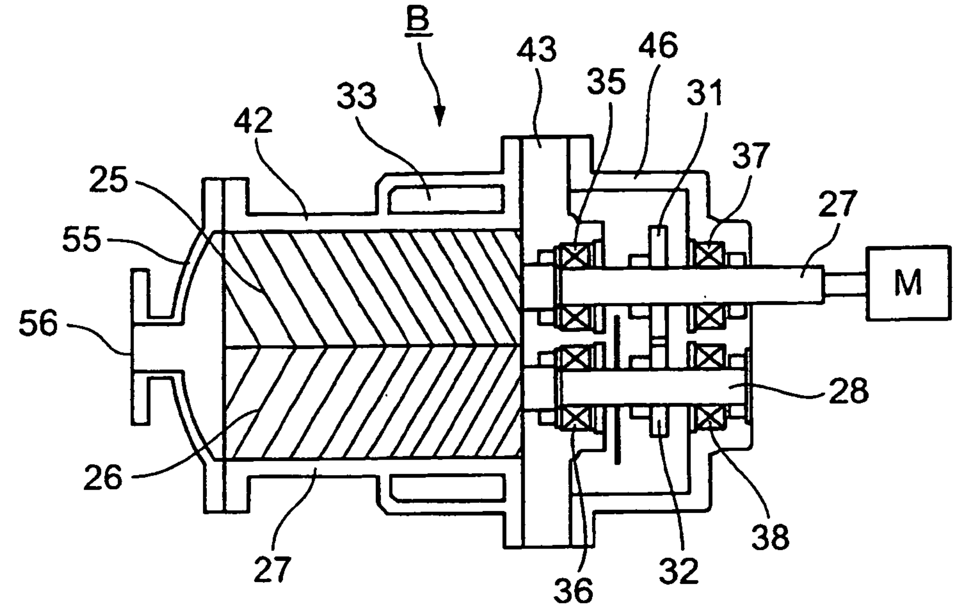


FIG. 3

(a)


B
43
46
35
31
33
42
37
25
27
55
M
56
28
26
38
27
32
36

(b)

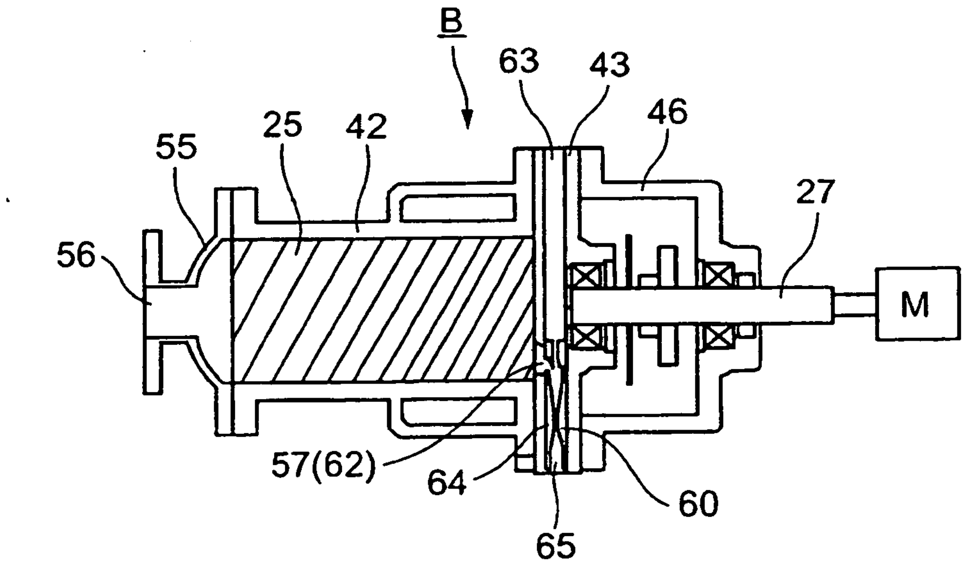

B
63
43
46
25
42
55
27
56
M
57(62)
64
60
65

FIG. 4

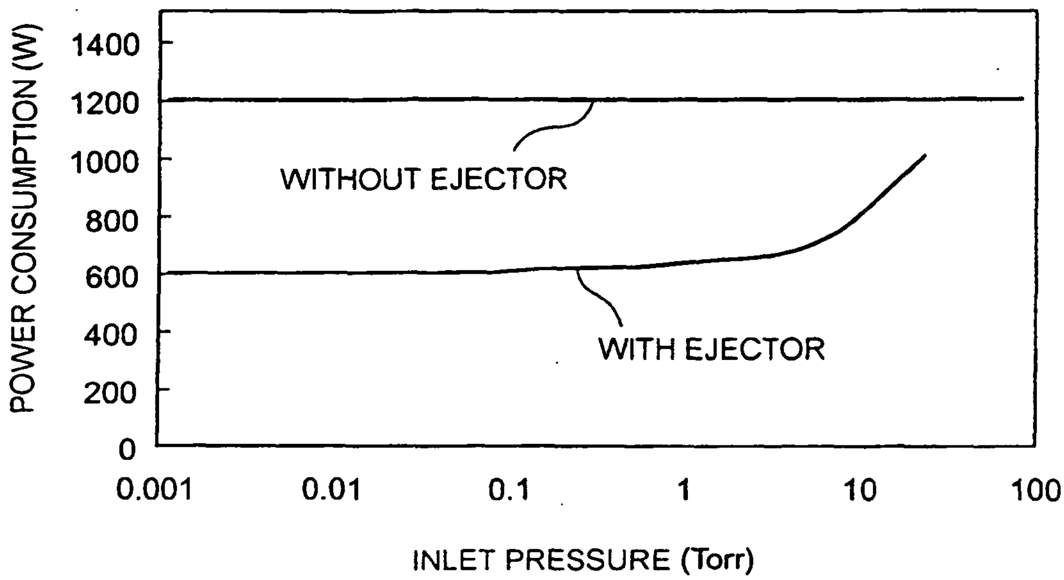

POWER CONSUMPTION (W)
1400
1200
1000
800
600
400
200
0
WITHOUT EJECTOR
WITH EJECTOR
0.001
0.01
0.1
1
10
100
INLET PRESSURE (Torr)

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002039061 A **[0020]**
- JP 63085292 A **[0022]**