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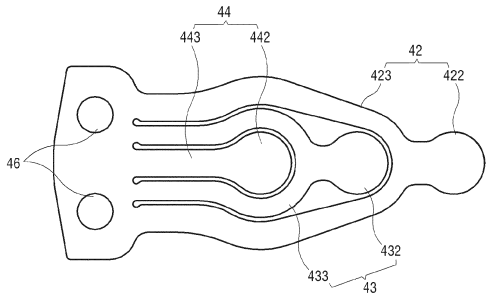
(54) COMPRESSOR AND ELECTRONIC DEVICE USING THE SAME

(57) The disclosure relates to a compressor that has a plurality of discharge ports and discharge valves disposed in each of the discharge ports. The compressor includes: a compression cylinder configured to have a plurality of discharge ports for discharging compressed gas provided in a predetermined direction; and a plurality of discharge valves configured to be provided in the plurality of discharge ports to control an amount of discharged gas, in which each of the discharge valves includes: a valve neck configured to have one end fixed in a plate shape having elasticity and extend along an arrangement direction of the plurality of discharge ports from the one end; and a valve head configured to be provided at the other end of the valve neck to cover each of the discharge ports. According to the compressor of the disclosure, it is possible to manufacture the compressor compactly and reduce manufacturing and maintenance costs of the compressor by reducing the area occupied by the plurality of discharge valves.

FIG. 7



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Description

[Technical Field]

[0001] The disclosure relates to an electronic device using a compressor such as an air conditioner, a refrigerator, and a freezer, and more particularly, to a compressor having a plurality of discharge valves applied to multiple discharge ports.

[Background Art]

[0002] A compressor refers to a mechanical device that increases pressure by compressing gas, and is divided into a reciprocating type compressor and a rotary type compressor according to the operating principle. The reciprocating type compressor is a type that converts a rotational motion of a motor into a linear reciprocating motion of a piston in a cylinder through a crankshaft and a connecting rod to suck and compress gas. Examples of the rotary type compressor include a rotary compressor that sucks and compresses gas while a roller rotates in a cylinder by a rotational motion of a motor and a scroll compressor that continuously sucks and compresses gas while a turning scroll performs an orbital motion in a certain direction from a center of a fixed scroll by a rotational motion of a motor. The existing compressor has one discharge hole and a discharge valve optimized for an operating speed (rpm) of a displacement amount in a cylinder.

[0003] A constant-speed type compressor needs to increase a size of a discharge hole in order to secure a flow rate of a discharge refrigerant and reduce a flow resistance. The enlargement of the size of the discharge hole increases a dead volume and a size of a discharge valve. The increase in the dead volume causes a decrease in cooling power, and the increase in the size of the discharge valve increases the noise due to the increase in the amount of impact, thereby reducing reliability.

[0004] In a variable type compressor, compression efficiency decreases when an operating speed of a wide range exceeds a specific range where peak efficiency occurs. In consideration of the compression efficiency aspect of the variable compressor, it is advantageous to reduce the size of the discharge hole in low-speed operation, but it is advantageous to enlarge the discharge hole in high-speed operation. As a result, the overcompression generation width increases according to the behavior of the discharge valve, so the compression efficiency decreases.

[0005] In order to solve the problems of the single discharge port and the discharge valve, a compressor employing a plurality of discharge holes and discharge valves has been disclosed. However, such a plurality of discharge holes and discharge valves are an obstacle to the compaction of the compressor due to the increase in the occupied area. In addition, individually installing the plurality of discharge valves corresponding to the plurality of discharge holes causes not only an increase in manufacturing cost but also inconvenience of maintenance.

[Disclosure]

[Technical Problem]

[0006] Accordingly, an object of the disclosure is to provide a compact compressor and an electronic device using the same.

[0007] Accordingly, an object of the disclosure is to provide a compressor capable of improving production cost, part management, and assembling performance, and an electronic device using the same.

[Technical Solution]

[0008] According to an aspect of the present disclosure, a compressor includes: a compression cylinder configured to have a plurality of discharge ports for discharging compressed gas provided in a predetermined direction; and a plurality of discharge valves configured to be provided in the plurality of discharge ports to control an amount of discharged gas, in which each of the discharge valves includes: a valve neck configured to have one end fixed in a plate shape having elasticity and extend along an arrangement direction of the plurality of discharge ports from the one end; and a valve head configured to be provided at the other end of the valve neck to cover each of the discharge ports. According to the compressor of the disclosure, it is possible to manufacture the compressor compactly and reduce manufacturing and maintenance costs of the compressor by reducing the area occupied by the plurality of discharge valves.

[0009] The valve neck of at least one of the plurality of discharge valves may surround and extend at least some of the other discharge valves, thereby reducing the area occupied by the plurality of discharge valves.

[0010] The plurality of discharge valves may be sequentially opened, thereby preventing the overcompression of gas.

[0011] The plurality of valve necks may be integrally fixedly supported, so the plurality of discharge valves may be configured integrally.

[0012] A valve stopper of the compressor that restricts deformation of the plurality of discharge valves may extend along an arrangement direction of the plurality of discharge ports to cover all of the plurality of discharge valves, thereby reducing the manufacturing and maintenance costs.

[0013] A valve keeper of the compressor that restricts maximum deformation of the plurality of discharge valves may extend along the arrangement direction of the plurality of discharge ports to cover all of the plurality of discharge valves, thereby reducing the manufacturing and maintenance costs.

[0014] At least one of the plurality of discharge valves

may be provided in the other discharge valves, thereby reducing the area occupied by the plurality of discharge valves.

[0015] The plurality of discharge ports may be arranged in a linear direction, and the plurality of discharge valves may extend in a straight line along the linear direction, thereby reducing the area occupied by the plurality of discharge valves.

[0016] The plurality of discharge ports may be arranged in a circumferential direction of a predetermined curvature, and the plurality of discharge valves may extend along the circumferential direction, thereby reducing the area occupied by the plurality of discharge valves.

[0017] The plurality of discharge ports may have different diameters, thereby easily controlling the discharge amount of gas.

[0018] According to another aspect of the disclosure, a compressor includes: a compression cylinder configured to have a plurality of discharge ports for discharging compressed gas provided in a predetermined direction; a plurality of discharge valves configured to be provided in the plurality of discharge ports; and a valve keeper configured to extend along the arrangement direction of the plurality of discharge ports to cover all of the plurality of discharge valves and prevent the plurality of discharge valves from being deformed.

[0019] According to still another aspect of the disclosure, a compressor includes: a compression cylinder configured to have a cylinder that forms a compression space for compressing gas and a valve plate that has a plurality of discharge ports for discharging the compressed gas provided in a predetermined direction; and a plurality of discharge valves configured to have a plurality of valve heads that are provided in the plurality of discharge ports and a plurality of valve necks that are perpendicular to the arrangement direction of the plurality of discharge ports in the plurality of valve heads and extend toward a point on a line passing through centers of both outermost discharge ports, in which at least one of the plurality of valve necks extends to gradually narrow toward the one point.

[0020] An angle between the two adjacent valve necks may be 15° or less.

[0021] A sum of inner diameters of the plurality of discharge ports may be 39% or less of an inner diameter of the cylinder.

[0022] There is provided an electronic device comprising a compressor, in which the compressor includes a compression cylinder configured to have a plurality of discharge ports for discharging compressed gas provided in a predetermined direction; and a plurality of discharge valves configured to be provided in the plurality of discharge ports to control an amount of discharged gas, and each of the discharge valves includes a valve neck configured to have one end fixed in a plate shape having elasticity and extend along an arrangement direction of the plurality of discharge ports from the one end; and a valve head configured to be provided at the other end of the valve neck to cover each of the discharge ports.

[Advantageous Effects]

[0023] According to the disclosure, it is possible to provide the compact compressor by reducing the occupied area of the plurality of discharge valves while effectively controlling the discharge amount of the compressed gas through the plurality of discharge ports and discharge valves.

[0024] Further, in the compressor according to the discourse, since the plurality of discharge valves may be manufactured to be compact and integral, it is possible to reduce the production cost and improve the part management and assembly performance.

[Description of Drawings]

[0025]

FIG. 1 is a perspective view illustrating a compressor according to a first embodiment of the disclosure.

FIG. 2 is a perspective view of the compressor with a container removed from FIG. 1.

FIG. 3 is a cross-sectional view taken along line A-A of FIG. 2.

FIGS. 4 and 5 are schematic diagrams for explaining a gas compression process in a cylinder block of a reciprocating type compressor.

FIG. 6 is an exploded perspective view illustrating a cylinder block in FIG. 2.

FIG. 7 is a plan view illustrating a discharge valve unit according to a first embodiment of the disclosure.

FIG. 8 is a diagram illustrating an operating state of the discharge valve unit according to the first embodiment of the disclosure.

FIG. 9 is a plan view illustrating a state in which the discharge valve unit of FIG. 7 is applied to a cylinder.

FIG. 10 is a graph illustrating a peak discharge pressure in a low speed operation region.

FIG. 11 is a graph illustrating a peak discharge pressure in a medium speed operation region.

FIG. 12 is a graph illustrating a peak discharge pressure in a high speed operation region.

FIG. 13 is a plan view illustrating a discharge valve unit according to a second embodiment of the disclosure.

FIG. 14 is a plan view illustrating a discharge valve unit according to a third embodiment of the disclosure.

FIG. 15 is a plan view illustrating a discharge valve unit of a compressor according to a fourth embodiment of the disclosure.

FIG. 16 is a plan view illustrating an inner diameter of a compression space of a cylinder of the disclosure and an inner diameter of a plurality of discharge ports.

[Mode for Disclosure]

[0026] Hereinafter, in this document, a compressor 1 used in electronic devices such as an air conditioner, a refrigerator, and a freezer will be described in detail with reference to the accompanying drawings. Embodiments described below describe a sealed reciprocating type compressor 1 to aid understanding of the disclosure, which is illustrative. Unlike the embodiments described herein, it should be understood that various modifications such as a rotary type compressor and a scroll compressor may be implemented. However, when it is decided that a detailed description for the known functions or components related to the disclosure may obscure the gist of the disclosure, the detailed description and concrete illustration will be omitted.

[0027] FIG. 1 is a perspective view illustrating a sealed reciprocating type compressor 1 according to a first embodiment of the disclosure. The sealed reciprocating type compressor 1 according to the first embodiment of the disclosure is accommodated in an inner space of a container 2 in a sealed state. The container 2 is configured by combining an upper container 2-1 and a lower container 2-2 while accommodating the compressor 1.

[0028] FIG. 2 is a perspective view illustrating the compressor 1 of FIG. 1, and FIG. 3 is a cross-sectional view taken along line A-A of FIG. 2.

[0029] Referring to FIGS. 2 and 3, the compressor 1 includes a motor 10 and a cylinder block 20.

[0030] The motor 10 includes a rotor 12, a stator 14 and a rotating shaft 16 coupled to the rotor 12. The rotating shaft 16 includes a motor central shaft part 16-1 and an eccentric shaft part 16-2. One end portion of a connecting rod 18 is coupled to the eccentric shaft part 16-2. The other end portion of the connecting rod 18 is coupled to a piston 22 inserted into a compression space PS of the cylinder 21. The connecting rod 18 converts a rotational motion of the rotor 12 into a linear reciprocating motion of the piston 22 disposed in the compression space PS.

[0031] The cylinder block 20 includes a cylinder 21 that has a cylindrical compression space PS provided therein, a piston 22 that is inserted into the compression space PS, a valve plate 23 that is provided on one side of the cylinder 21, a gas suction part 24 that sucks gas, for example, a refrigerant from an outside, and a gas discharge part 25 that discharges gas compressed in the cylinder 21.

[0032] FIGS. 4 and 5 are schematic diagrams for explaining a gas compression process in the cylinder block 20 of the reciprocating type compressor 1. The cylinder block 20 is inserted into the cylindrical compression space PS so that the piston 22 can reciprocate. A valve plate 23 is coupled to one side of the cylinder 21. The valve plate 23 includes a suction port 232 that sucks gas and a discharge port 233 that discharges gas. The valve plate 23 includes a suction valve 32 that blocks the suction port 232 on an inner surface of the compression space PS and a discharge valve 44 that blocks the discharge port 233 on an outer surface of the compression space PS. The suction valve 32 and the discharge valve 44 are made of a plate material having elasticity. One side of the suction valve 32 and the discharge valve 44 is fixed and the other side thereof is a free end portion.

[0033] In FIG. 4, when the piston 22 retreats within the cylinder 21, the suction valve 32, which is blocking the suction port 232 located on the inner surface of the valve plate 23, is elastically deformed and opened by suction force. As a result, gas is sucked through the suction port 232 and fills the compression space PS. At this time, the discharge valve 44 that blocks the discharge port 233 located on the outer surface of the valve plate 23 seals the discharge port 233 by the suction force.

[0034] In FIG. 5, when the piston 22 advances in the cylinder 21, the gas in the compression space PS is compressed. Due to this compression force, the discharge valve 44 that is blocking the discharge port 233 located on the outer surface of the valve plate 23 is deformed and opened. As a result, the gas is discharged to the gas discharge part 25 through the discharge port 233. At this time, the suction valve 32 that blocks the suction port 232 seals the suction port 232 by compression force.

[0035] FIG. 6 is an exploded perspective view illustrating the cylinder block 20 of the compressor 1 according to an embodiment of the disclosure.

[0036] As illustrated in FIG. 6, the cylinder block 20 includes a cylinder 21 that has the cylindrical compression space PS in a center thereof, the piston 22 that is inserted into the compression space PS of the cylinder 21, the valve plate 23 that is coupled to one surface of the cylinder 21, the gas suction part 24 that sucks gas, and the gas discharge part 25 that discharges gas. In addition, the cylinder block 20 includes a suction valve unit 30 that is disposed on the inner surface of the cylinder 21 side of the valve plate 23, a discharge valve unit 40 that is at a position corresponding to three discharge ports 233, 234, and 235 on the outer surface of the valve plate 23, a valve stopper 50 that covers the discharge valve unit 40, and a valve keeper 60 that covers the valve stopper 50.

[0037] The cylinder 21 has a substantially hexahedral shape and has the cylindrical compression space PS penetrating through the center thereof.

[0038] The piston 22 is inserted into the cylindrical compression space PS of the cylinder 21 to reciprocate back and forth. The piston 22 is connected to a connecting rod (18 in FIG. 3) at the rear of the cylinder 21.

[0039] The valve plate 23 is coupled to the front of the cylinder 21. The valve plate 23 is provided with one suction port 232 and the first to third discharge ports 233, 234 and 235 that communicate with the compression space PS. The valve plate 23 includes a first bolt hole 236 that fastens a first bolt 66 and a second bolt hole 237 that fastens a second bolt 67. The first bolt 66 fastens one end portion of the discharge valve unit 40, the valve stopper 50, and the valve keeper 60, respectively. The

second bolt 67 is fastened to the second bolt hole 237 to fix the other end portion of the valve keeper 60.

[0040] The gas suction part 24 is a suction muffler 242 that reduces noise caused by the suction of gas, and a gas suction pipe 244 that transfers the gas passing through the suction muffler 242 to the suction port 232 of the valve plate 23. The suction muffler 242 includes a plurality of expansion parts (not illustrated) provided therein and a connection passage (not illustrated) connecting between the plurality of expansion portions with a narrow width.

[0041] The gas discharge part 25 is coupled to the valve plate 23 with a predetermined space therein. The gas discharge part 25 includes an exhaust muffler (not illustrated) having a structure similar to the above-described suction muffler 242 in a predetermined space.

[0042] The suction valve unit 30 is made of a plate material having elasticity of magnitude corresponding to one surface of the cylinder 21 and is provided with a suction valve 32 and three discharge gas passage holes 33, 34, and 35. The suction valve unit 30 has a valve head 322 that blocks the suction port 232 of the valve plate 23 to be described later, and a valve neck 324 that integrally extends from the valve head 322. The valve neck 324 has the valve head 322 whose opposite end portion is integrally connected to the plate-shaped suction valve unit 30. That is, the suction valve 32 may be formed in the plate-shaped suction valve unit 30 in a suction valve shape by a punching or shearing process. Obviously, the suction valve 32 may be separately manufactured instead of the punching or shearing process, and fixedly installed on the valve plate 23.

[0043] The discharge valve unit 40 includes a fixed end portion 41 on one side thereof and first to third discharge valves 42, 43, and 44 integrally extending from the fixed end portion 41. The first to third discharge valves 42, 43, and 44 open and close the first to third discharge ports 233, 234, and 235 of the valve plate 23, respectively. One side of each of the first to third discharge valves 42, 43, and 44 is fixed and the other side thereof is free. Accordingly, the first to third discharge valves 42, 43, and 44 block the first to third discharge ports 233, 234, and 235, respectively, and then when the gas compression force of the compression space PS reaches a predetermined range, each free end is elastically deformed and opens sequentially. The fixed end of the discharge valve unit 40 is provided with a pair of first bolt passage holes 46 through which a pair of first bolts 66 passes. The first bolt through hole 46 corresponds to the first bolt hole 236 of the valve plate 23.

[0044] The valve stopper 50 is disposed to cover the first to third discharge ports 233, 234, and 235. The valve stopper 50 includes a stopper body 52, a fixed end portion 53 located at one end of the stopper body 52, and a free end portion 54 located at the other end thereof. The stopper body 52 is bent upward at a predetermined angle from the fixed end portion 53 toward the free end portion 54. As a result, even if the first to third discharge valves 42, 43, and 44 are deformed, the deformation of the first to third discharge valves 42, 43, and 44 is limited by the stopper body 52 of the valve stopper 50. The fixed end portion 53 of the valve stopper 50 is provided with a pair of second bolt holes 56 which a pair of first bolts 66 passes through. The second bolt through hole 56 corresponds to the first bolt through hole 46 of the discharge valve unit 40 and the first bolt hole 236 of the valve plate 23.

[0045] The valve keeper 60 is disposed to cover the valve stopper 50. The valve keeper 60 includes a keeper body 62, a first fixed end portion 63 located at one end of the keeper body 62, and a second fixed end portion 64 located at the other end thereof. The keeper body 62 is bent to be upwardly inclined from a first fixed end portion 63 and then downwardly bent at the end. The valve keeper 60 restricts the valve stopper 50 from being deformed to a predetermined angle or more to prevent the first to third discharge valves 42, 43, and 44 and the valve stopper 50 from being excessively deformed. A pair of first bolts 66 is fastened to the first fixed end portion 63. A second fixing bolt is fixed to the second fixed end portion 64. The first fixing bolt 66 sequentially passes through the second bolt through hole 56 of the valve stopper 50 and the first bolt through hole 46 of the discharge valve unit 40, and then is fastened to the first bolt hole 236. The second fixing bolt 67 is fastened to the second bolt hole 237 of the valve plate 23.

[0046] FIG. 7 is a plan view illustrating the discharge valve unit 40 according to the first embodiment of the disclosure. As illustrated, the discharge valve unit 40 includes the first to third discharge valves 42, 43, and 44 disposed on the same plane. The first to third discharge valves 42, 43, and 44 are integrally connected to the fixed end portion 41 of a unitary body. As the modified embodiment, the first to third discharge valves 42, 43, and 44 may be provided with individual fixed end portions. The discharge valve unit 40 is not limited only to three discharge valves, and may include two or four or more discharge valves.

[0047] The first discharge valve 42 includes a circular first valve head 422 that covers the first discharge port 233 of the valve plate 23 and a first valve neck 423 that branches into two from the first valve head 422 with a first space 45 therebetween and extends to the fixed end portion 41.

[0048] The second discharge valve 43 is accommodated in the first space part 45. The second discharge valve 43 includes a circular second valve head 432 that covers the second discharge port 234 of the valve plate 23 and a second valve neck 433 that branches into two from the second valve head 432 with a second space 48 therebetween and extends to the fixed end portion 41.

[0049] The third discharge valve 44 is accommodated in the second space part 48. The third discharge valve 44 includes a circular third valve head 442 that covers the third discharge port 235 of the valve plate 23 and a third valve neck 443 that extends in a straight line from the third valve head 442 to the fixed end portion 41.

[0050] As described above, the first valve neck 423 of the first discharge valve 42 extends surrounding the second discharge valve 43, and the second valve neck 433 of the second discharge valve 43 extends surrounding the third discharge valve 44.

[0051] The first to third discharge valves 42, 43, and 44 are not limited only to the shape illustrated in FIG. 7, but various modifications may be made within the scope of the disclosure. For example, the first discharge valve 42 may accommodate the second discharge valve 43 in the same plane, and the third discharge valve 44 may be designed to be separated from the first and second discharge valves 42 and 43.

[0052] FIG. 8 is a view illustrating an open state of the first to third discharge valves 42, 43, and 44. As illustrated, the first discharge valve 42, the second discharge valve 43, and the third discharge valve 44 are sequentially opened to a height of about 2.7 mm, a height of about 1.6 mm, and a height of about 0.7 mm. As such, the first to third discharge valves 42, 43, and 44 may be sequentially opened due to a difference in rigidity due to different lengths of the first to third valve necks 423, 433, and 443. That is, the first valve neck 423 having the longest length, the second valve neck 433 having the intermediate length, and the third valve neck 443 having the shortest length may be sequentially opened. Obviously, each of the above-described discharge valves 42, 43, and 44 is an example, and an opening height may be adjusted by adjusting the rigidity by designing different lengths or widths.

[0053] Hereinafter, the operation of the discharge valve unit 40 according to the first embodiment of the disclosure will be described with reference to FIG. 9. As illustrated, the first to third discharge ports 233, 234, and 235 are arranged in a vertical linear direction in the compression space PS of the cylinder 21. In the discharge valve unit 40, the first to third valve heads 422, 432, and 442 cover the first to third discharge ports 233, 234, and 235, respectively. In addition, the first to third valve necks 423, 433, and 443 extend along the arrangement direction of the first to third discharge ports 233, 234, and 235, that is, in the vertical linear direction. At this time, the first to third valve necks 423, 433, and 443 have a shape surrounding the circular valve heads 422, 432, and 442 in a circular curve.

[0054] The first to third discharge valves 42, 43, and 44 are sequentially opened in order of less rigidity when the pressure inside the cylinder rises above a certain level. When the motor is operated at a low speed, for example, 1,450 rpm, the first discharge valve 42 with low rigidity due to the relatively low internal pressure of the cylinder opens first and larger, and the second discharge valve 43 in the middle is opened later and smaller than the first discharge valve 42, and the opening of the third discharge valve 44 having the relatively highest rigidity is restricted. On the other hand, when the motor is operated at a high speed, for example, 3,700 rpm, the opening amount of the third discharge valve 44 having high rigidity due to a relatively high internal pressure of the cylinder may be increased.

[0055] According to the characteristics of the disclosure, the first to third discharge valves 42, 43 and 44 may perform the following roles.

[0056] The first discharge valve 42 serves to reduce the peak pressure and improve an input of low rpm together with the second discharge valve 43.

[0057] The second discharge valve 43 serves to naturally connect the valve opening/closing delay of the first and third discharge valves 42 and 44. In addition, the second discharge valve 43 reduces the peak pressure together with the first discharge valve 42 and is limited in opening at a relatively low pressure at a low rpm, thereby optimizing the efficiency of the first discharge valve.

[0058] The third discharge valve 44 may affect the occurrence and period of pressure peaks and prevent a decrease in cooling power due to low valve stiffness at high rpm, and the opening is limited for a relatively low pressure at a low rpm, so the first and second discharge valves 42 and 43 may optimize compression efficiency.

[0059] Table 1 below shows the peak discharge pressure generated by the operation area of the compressor, and FIGS. 10 to 12 each are graphs illustrating the peak discharge pressure according to the change in the volume (cm^3) of the compression space PS of the cylinder 21 at the low speed, the medium speed, and the high speed operation.

[Table 1]

rpm	1,450	1,850	3,700
Prior art (kgf/cm^2)	6.8	7.0	8.4
The disclosure (kgf/cm^2)	6.3	6.4	7.6
Improvement rate (%)	7.0 ↓	8.6 ↓	9.5 ↓

[0060] In FIG. 10, when the compression space PS of the cylinder 21 is compressed at 1,450 rpm, the first discharge valve 42 of the disclosure starts to open, the second discharge valve 43 is sequentially opened, and the third discharge valve 44 is restricted from opening. A maximum peak discharge pressure is improved by about 7.0% compared to the prior art. In FIG. 11, when the compression space PS of the cylinder 21 is compressed at 1,850 rpm, the first discharge valve 42 of the disclosure starts to open, the second discharge valve 43 and the third discharge valve 44 are sequentially opened. At this time, the maximum peak discharge pressure is improved by about 8.6% compared to the prior art. In FIG. 12, when the compression space PS of the cylinder 21 is compressed at 3,700 rpm, the first discharge valve 42 of the disclosure starts to open, the second discharge valve 43 and the third discharge valve 44 are sequentially opened. At this time, the maximum peak discharge pressure is improved by about 9.5% compared to the prior art.

[0061] As described above, since the compressor 1 to

which the plurality of discharge ports 233, 234, and 235 are applied may be designed to have a relatively smaller inner diameter of each discharge port 233, 234, and 235 than the conventional compressor using one discharge port, it is possible to equally or additionally secure the flow rate of the discharged gas and minimize the flow resistance.

[0062] In addition, when the size of the plurality of discharge ports 233, 234, and 235 is reduced, the size of the corresponding plurality of discharge valves 42, 43, and 44 may also be reduced, so the impact when the discharge valves 42, 43, and 44 are opened or closed may be reduced, thereby improving the reliability and the noise problem.

[0063] In addition, the plurality of discharge valves 42, 43, and 44 are each sequentially opened and closed due to different stiffness, and as a result, it is possible to improve the compression efficiency by improving the over-compression of gas. Such sequential opening and closing may be controlled by differently designing the sizes of the inner diameters of each of the plurality of discharge ports 233, 234, and 235, the widths of each of the valve necks, and the lengths of the valve necks.

[0064] In addition, the first to third valve necks 423, 433, and 443 extend along the arrangement direction of the plurality of discharge ports 233, 234, and 235, thereby narrowing the spacing of the plurality of discharge ports 233, 234, and 235.

[0065] The plurality of discharge valves 42, 43, and 44 have the same number of valves as the plurality of discharge ports 233, 234, and 235, but may be integrally formed. In this way, when the plurality of discharge valves 42, 43, and 44 are integrally manufactured, it is possible to improve the production cost, the part management, and the assembly performance.

[0066] In addition, since the plurality of discharge valves 42, 43, and 44 operate in the same direction as the straight line connecting the center lines of the plurality of discharge valves 42, 43, and 44 and are manufactured integrally, the plurality of discharge valves 42, 43, and 44 may occupy the minimum space, and thus the compact design may be implemented, thereby further increasing the rigidity difference between the discharge valves within a limited space.

[0067] FIG. 13 is a plan view illustrating a discharge valve unit 40 according to a second embodiment of the disclosure. As illustrated, the discharge valve unit 40 includes the first to third discharge valves 42, 43, and 44 disposed on the same plane. The first to third discharge valves 42, 43, and 44 are integrally connected to the fixed end portion 41 of a unitary body.

[0068] The first to third discharge ports 233, 234, and 235 are arranged in the vertical linear direction in the compression space PS of the cylinder 21. In the discharge valve unit 40, the first to third valve heads 422, 432, and 442 cover the first to third discharge ports 233, 234, and 235, respectively. In addition, the first to third valve necks 423, 433, and 443 extend along the arrangement direction of the first to third discharge ports 233, 234, and 235, that is, in the vertical linear direction.

[0069] The first discharge valve 42 includes a quadrangular first valve head 422 that covers the first discharge port 233 of the valve plate 23 and a linear first valve neck 423 that branches into two from the first valve head 422 with a first space therebetween and extends to the fixed end portion 41. The first discharge valve 42 accommodates the second discharge valve 43 and the third discharge valve 44 on the same plane in a predetermined first space.

[0070] The second discharge valve 43 is accommodated in the first space in the first discharge valve 42. The second discharge valve 43 includes a quadrangular second valve head 432 that covers the second discharge port 234 of the valve plate 23 and a second valve neck 433 that branches into two from the second valve head 432 with a second space therebetween and extends to the fixed end portion 41. The second discharge valve 43 accommodates the third discharge valve 44 on the same plane.

[0071] The third discharge valve 44 is accommodated in the second space. The third discharge valve 44 includes a quadrangular third valve head 442 that covers the third discharge port 235 of the valve plate 23 and a third valve neck 443 that extends in a straight line from the third valve head 442 to the fixed end portion 41.

[0072] As described above, in the discharge valve unit 40 according to the second embodiment of the disclosure, the first to third valve necks 423, 433, and 443 may extend along the arrangement direction of the plurality of discharge ports 233, 234, and 235, thereby narrowing the spacing of the plurality of discharge ports 233, 234, and 235.

[0073] FIG. 14 is a plan view illustrating the discharge valve unit 40 according to a third embodiment of the disclosure. As illustrated, the discharge valve unit 40 includes the first to third discharge valves 42, 43, and 44 disposed on the same plane. The first to third discharge valves 42, 43, and 44 are integrally connected to the fixed end portion 41 of a unitary body.

[0074] The first to third discharge ports 233, 234, and 235 are arranged in the circumferential direction in the compression space PS of the cylinder 21. In the discharge valve unit 40, the first to third valve heads 422, 432, and 442 cover the first to third discharge ports 233, 234, and 235, respectively. In addition, the first to third valve necks 423, 433, and 443 extend along the arrangement direction of the first to third discharge ports 233, 234, and 235, that is, in the circumferential direction.

[0075] The first discharge valve 42 includes a first valve head 422 that covers the first discharge port 233 of the valve plate 23 and a curved first valve neck 423 that branches into two from the first valve head 422 with a first space therebetween and extends to the fixed end portion 41. The first discharge valve 42 accommodates the second discharge valve 43 and the third discharge valve 44 on the same plane in a predetermined first

space.

[0076] The second discharge valve 43 is accommodated in the first space in the first discharge valve 42. The second discharge valve 43 includes a second valve head 432 that covers the second discharge port 234 of the valve plate 23 and a curved second valve neck 433 that branches into two from the second valve head 432 with a second space therebetween and extends to the fixed end portion 41. The second discharge valve 43 accommodates the third discharge valve 44 on the same plane.

[0077] The third discharge valve 44 is accommodated in the second space. The third discharge valve 44 includes a third valve head 442 that covers the third discharge port 235 of the valve plate 23 and a curved third valve neck 443 that extends from the third valve head 442 toward the fixed end portion 41.

[0078] As described above, in the discharge valve unit 40 according to the third embodiment of the disclosure, the first to third valve necks 423, 433, and 443 may extend along the arrangement direction of the plurality of discharge ports 233, 234, and 235, thereby narrowing the spacing of the plurality of discharge ports 233, 234, and 235.

[0079] FIG. 15 is a plan view illustrating a discharge valve unit 40 according to a fourth embodiment of the disclosure. As illustrated, the discharge valve unit 40 includes the first to third discharge valves 42, 43, and 44 disposed on the same plane. The first to third discharge valves 42, 43, and 44 are integrally connected to the fixed end portion 41 of a unitary body.

[0080] The first to third discharge ports 233, 234, and 235 are arranged in the vertical linear direction in the compression space PS of the cylinder 21. In the discharge valve unit 40, the first to third valve heads 422, 432, and 442 cover the first to third discharge ports 233, 234, and 235, respectively. In addition, the first to third valve necks 423, 433, and 443 are perpendicular to a straight line A passing through the center of the first to third discharge ports 233, 234, and 235 and extends toward a point P on a straight line B passing through the center of the second discharge port 234.

[0081] The first discharge valve 42 includes a quadrangular first valve head 422 that covers the third discharge port 233 of the valve plate 23 and a first valve neck 423 that extends so that a width thereof gradually decreases from the first valve head 422 toward the point P.

[0082] The second discharge valve 43 includes a quadrangular second valve head 432 that covers the second discharge port 234 of the valve plate 23 and a second valve neck 433 extends so that a width thereof gradually decreases from the second valve head 432 toward the point P.

[0083] The third discharge valve 44 includes a quadrangular third valve head 442 that covers the third discharge port 235 of the valve plate 23 and a third valve neck 443 that extends so that a width thereof gradually decreases from the third valve head 442 toward the point P.

[0084] As described above, in the discharge valve unit 40 according to the fourth embodiment of the disclosure, the first to third valve necks 423, 433, and 443 extend so that the width thereof decreases toward one point P, and as a result, the plurality of discharge ports 233, 234, and 235 can be arranged very close to each other so that an angle (α) therebetween is 15° or less.

[0085] FIG. 16 is a plan view illustrating an inner diameter Sr of the cylinder of the disclosure and inner diameters V1r, V2r, and V3r of the first to third discharge ports 233, 234, and 235. The sum of the inner diameters V1r, V2r, and V3r of the first to third discharge ports 233, 234, 235 is preferably 39% or less of the inner diameter Sr of the cylinder. If the sum of the inner diameters exceeds 39%, the interference between the adjacent discharge ports occurs and the compression efficiency decreases.

[0086] Each inner diameter V1r, V2r, and V3r of the first to third discharge ports 233, 234, and 235 may be set variously within a range of 39% or less of the inner diameter Sr of the cylinder, and may all be set equally to, for example, 13%, and may be all set differently.

[0087] As described above, according to an aspect of the present disclosure regarding to a compressor including a compression cylinder configured to have a plurality of discharge ports for discharging compressed gas provided in a predetermined direction and a plurality of discharge valves configured to be provided in the plurality of discharge ports to control an amount of discharged gas, in which each of the discharge valves includes a valve neck configured to have one end fixed in a plate shape having elasticity and extend along an arrangement direction of the plurality of discharge ports from the one end and a valve head configured to be provided at the other end of the valve neck to cover each of the discharge ports, it is possible to manufacture the compressor compactly and reduce manufacturing and maintenance costs of the compressor by reducing the area occupied by the plurality of discharge valves.

[0088] Also, the valve neck of at least one of the plurality of discharge valves may surround and extend at least some of the other discharge valves, thereby reducing the area occupied by the plurality of discharge valves, the plurality of discharge valves may be sequentially opened, thereby preventing the overcompression of gas, and the plurality of valve necks may be integrally fixedly supported, so the plurality of discharge valves may be configured integrally.

[0089] Also, a valve stopper of the compressor that restricts deformation of the plurality of discharge valves may extend along an arrangement direction of the plurality of discharge ports to cover all of the plurality of discharge valves, and a valve keeper of the compressor that restricts maximum deformation of the plurality of discharge valves may extend along the arrangement direction of the plurality of discharge ports to cover all of the plurality of discharge valves, thereby reducing the man-

ufacturing and maintenance costs.

[0090] Also, at least one of the plurality of discharge valves may be provided in the other discharge valves, and the plurality of discharge ports may be arranged in a linear direction, and the plurality of discharge valves may extend in a straight line along the linear direction, thereby reducing the area occupied by the plurality of discharge valves.

[0091] Also, the plurality of discharge ports may be arranged in a circumferential direction of a predetermined curvature, and the plurality of discharge valves may extend along the circumferential direction, thereby reducing the area occupied by the plurality of discharge valves, and the plurality of discharge ports may have different diameters, thereby easily controlling the discharge amount of gas.

[0092] Although the preferred embodiments of the disclosure have been illustrated and described above, the disclosure is not limited to the specific embodiments described above, and can be variously modified by those skilled in the art to which the disclosure pertains without departing from the gist of the disclosure claimed in the claims, and these modifications should not be understood individually from the technical ideas or prospects of the disclosure.

Claims

1. A compressor, comprising:

a compression cylinder configured to have a cylinder that forms a compression space for compressing gas and a valve plate that has a plurality of discharge ports for discharging the compressed gas provided in a predetermined direction; and

a plurafity of discharge valves configured to have a plurality of valve heads that are provided in the plurality of discharge ports and a plurality of valve necks that are perpendicular to the arrangement direction of the plurality of discharge ports in the plurality of valve heads and extend toward a point on a line passing through centers of both outermost discharge ports,

wherein at least one of the plurality of valve necks extends to gradually narrow toward the one point.

2. The compressor of claim 1, wherein the plurality of discharge valves are sequentially opened.

3. The compressor of claim 1, wherein the plurality of valve necks are integrally fixedly supported.

4. The compressor of claim 1, wherein an angle between the two adjacent valve necks is 15° or less.

5. The compressor of claim 1, wherein a sum of inner diameters of the plurality of discharge ports is 39% or less of an inner diameter of the cylinder.

6. The compressor of claim 1, further comprising:
a valve stopper configured to extend along the arrangement direction of the plurality of discharge ports to cover all of the plurality of discharge valves and restrict opening and closing of the plurality of discharge valves.

7. The compressor of claim 6, further comprising:
a valve keeper configured to extend along the arrangement direction of the plurality of discharge ports to cover the valve stopper and prevent the valve stopper from being deformed.

8. An electronic device comprising the compressor of claim 1.

FIG. 1

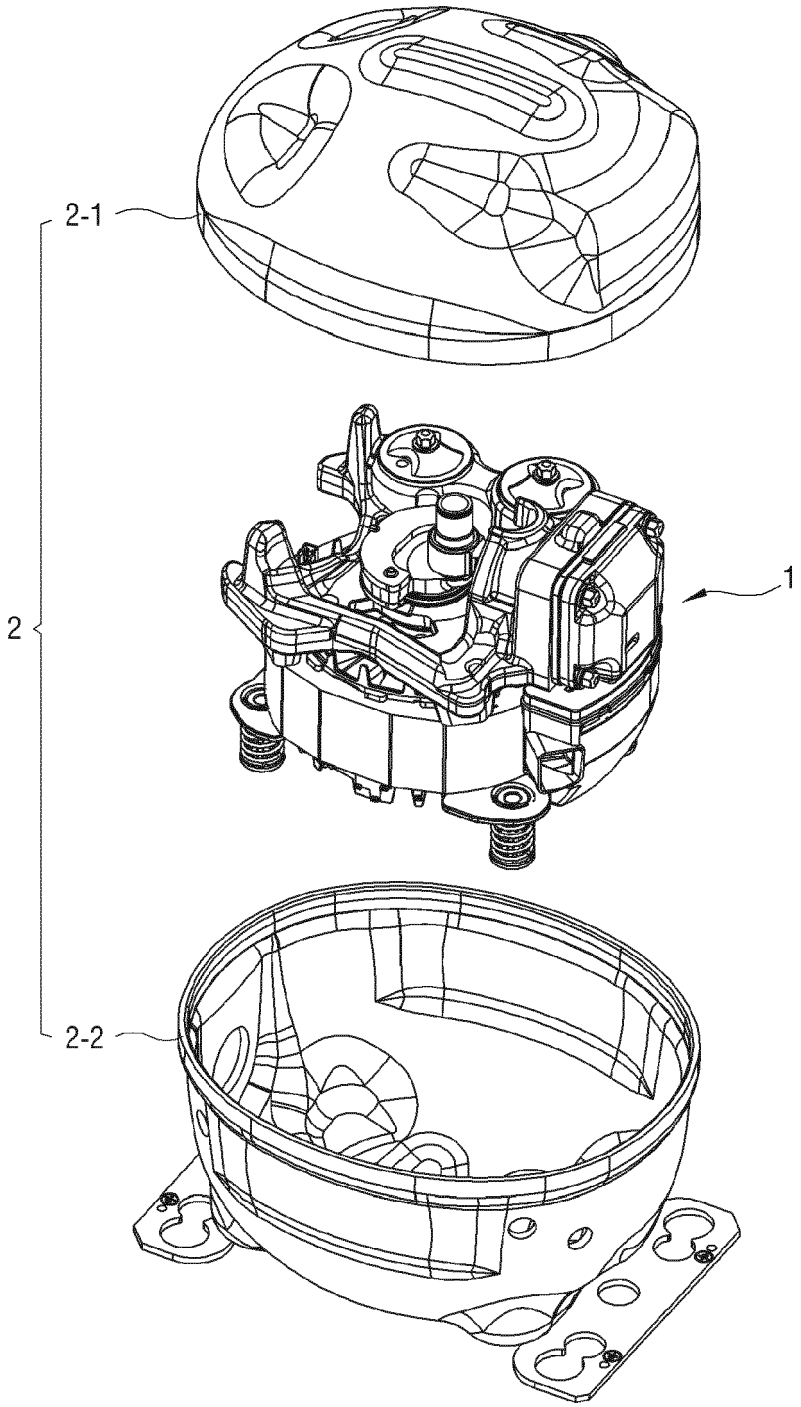


FIG. 2

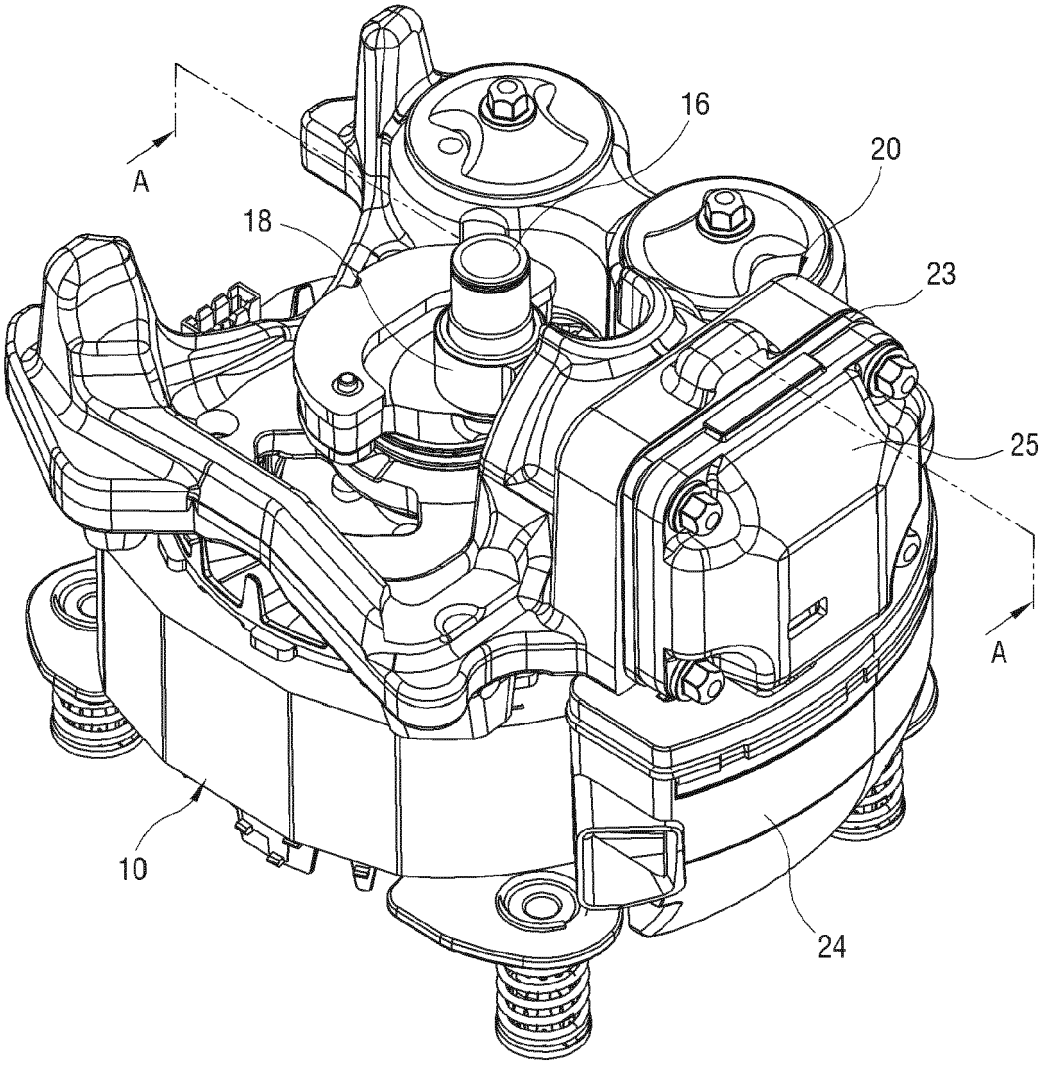


FIG. 3

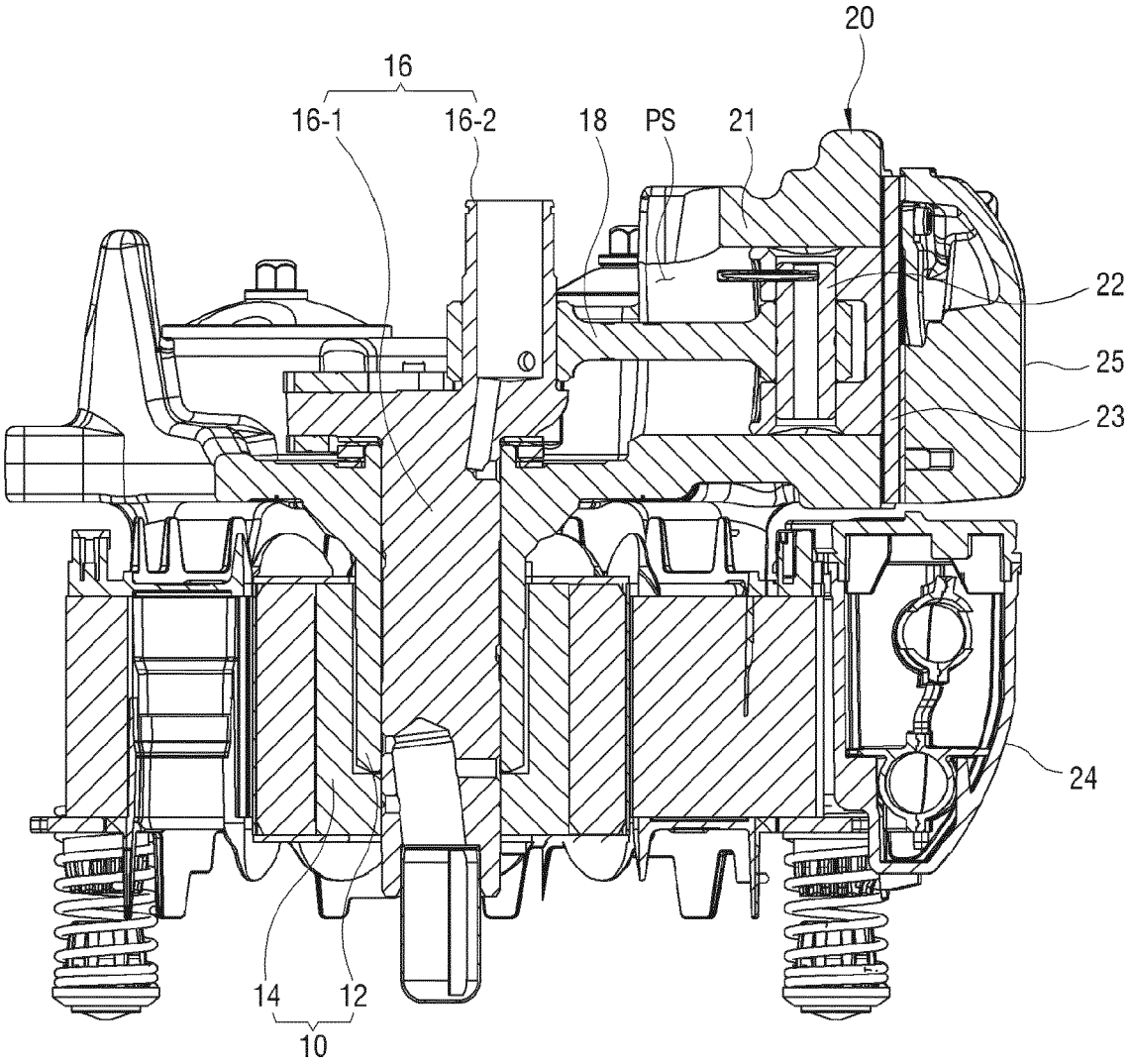


FIG. 4

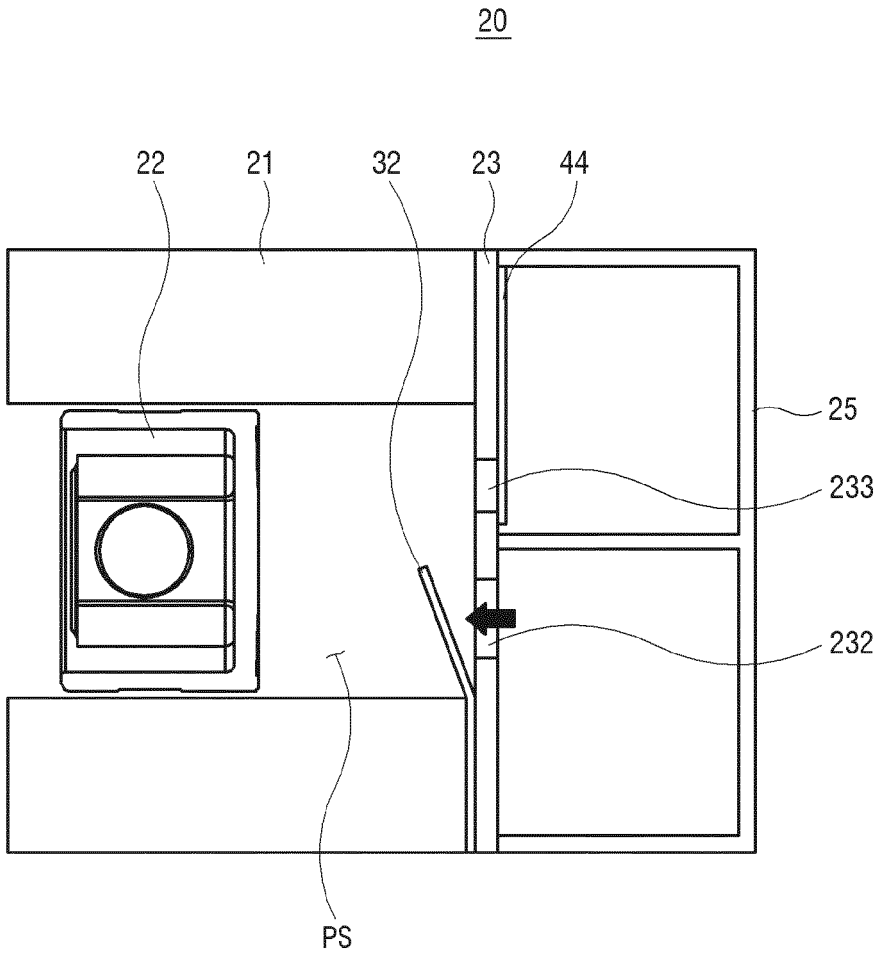


FIG. 5

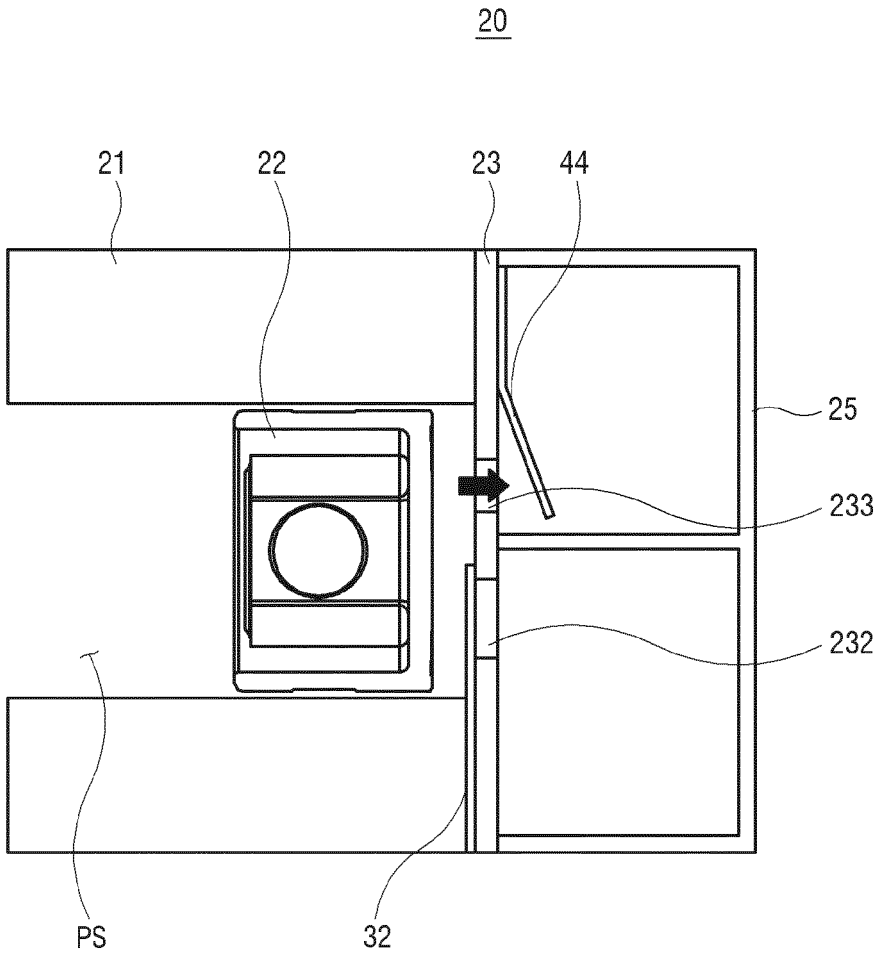
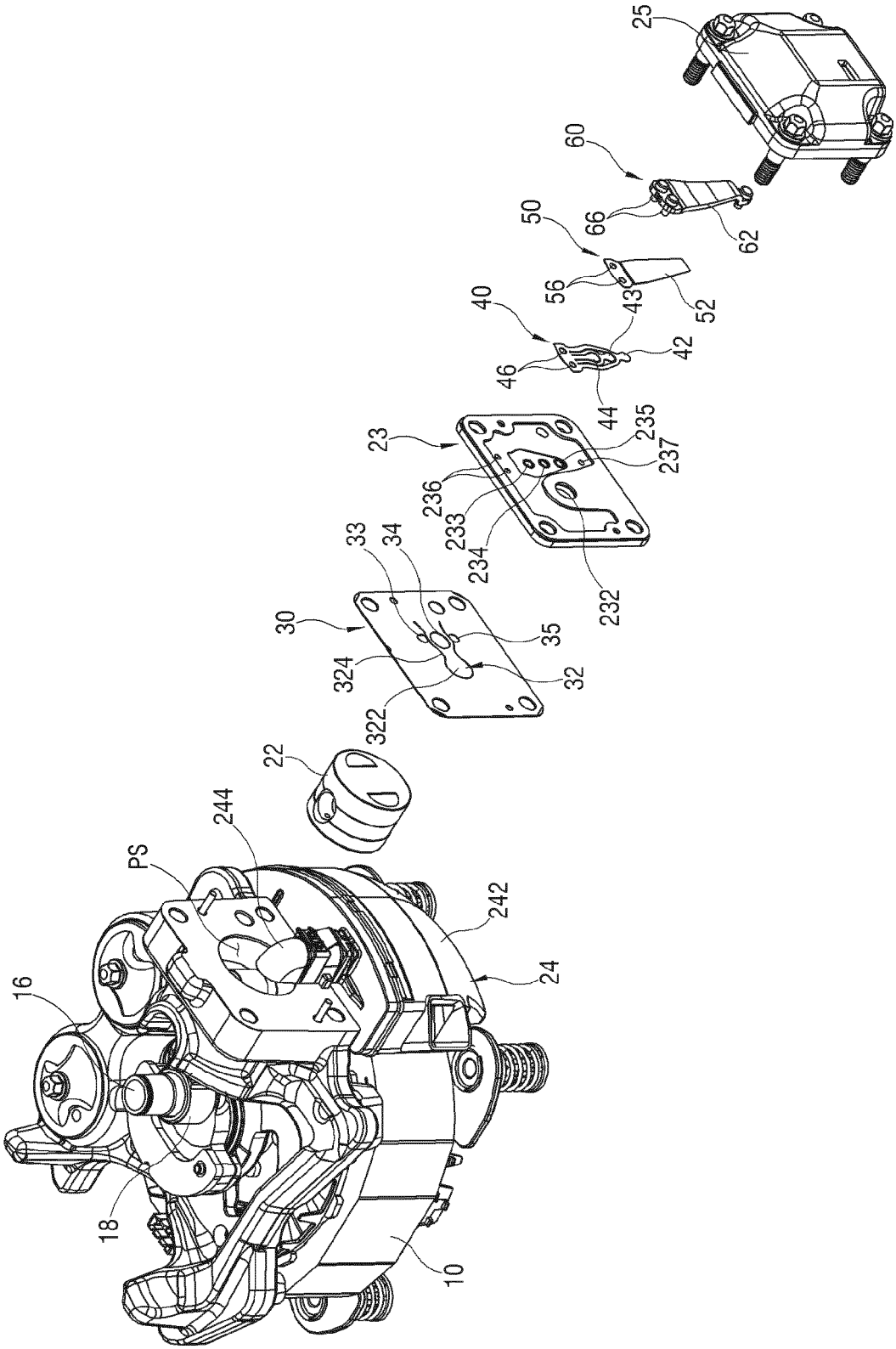


FIG. 6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66
62
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43
52
40
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42
44
23
235
237
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32
322
22
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PS
242
24
16
18
10

FIG. 7

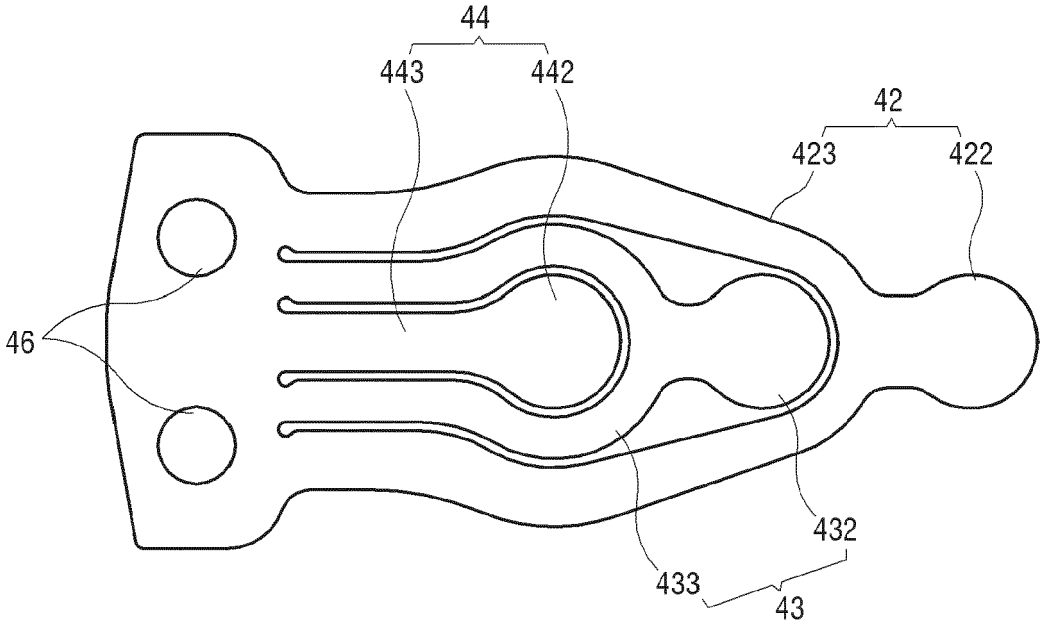


FIG. 8

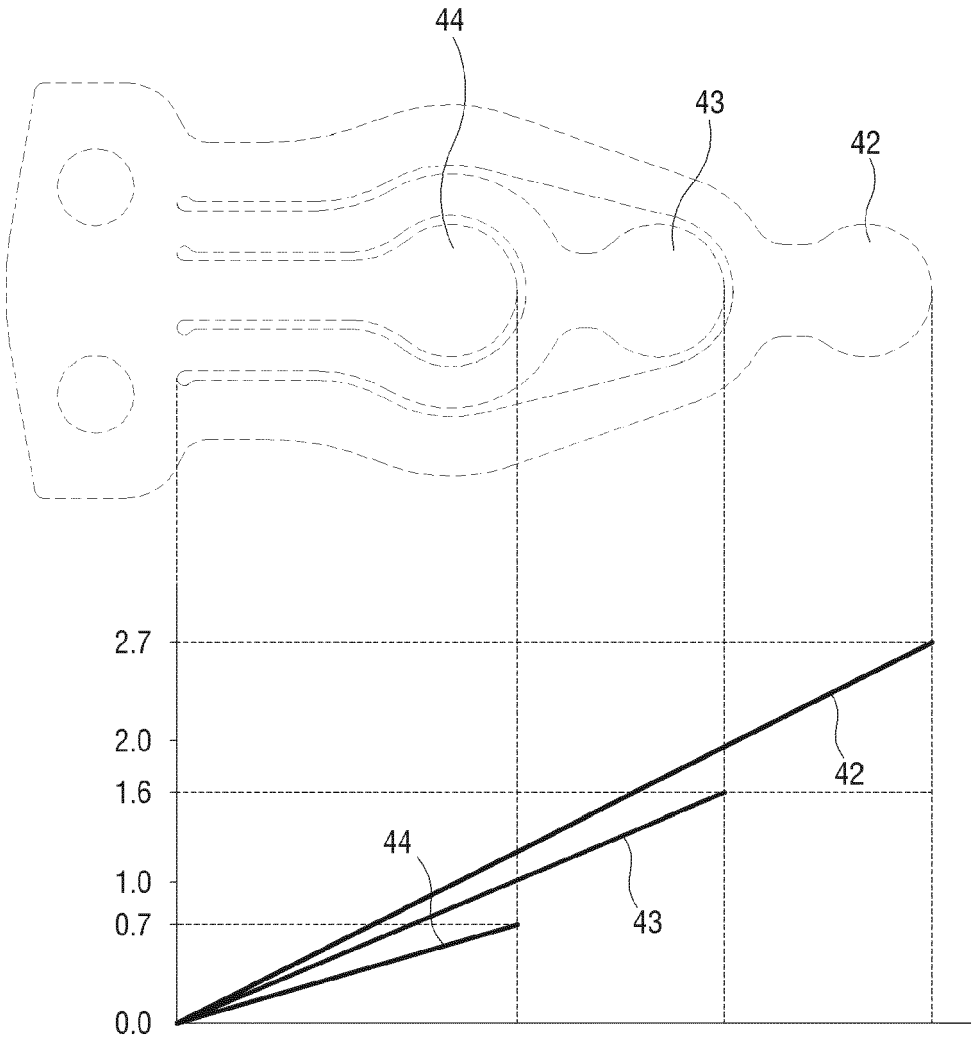


FIG. 9

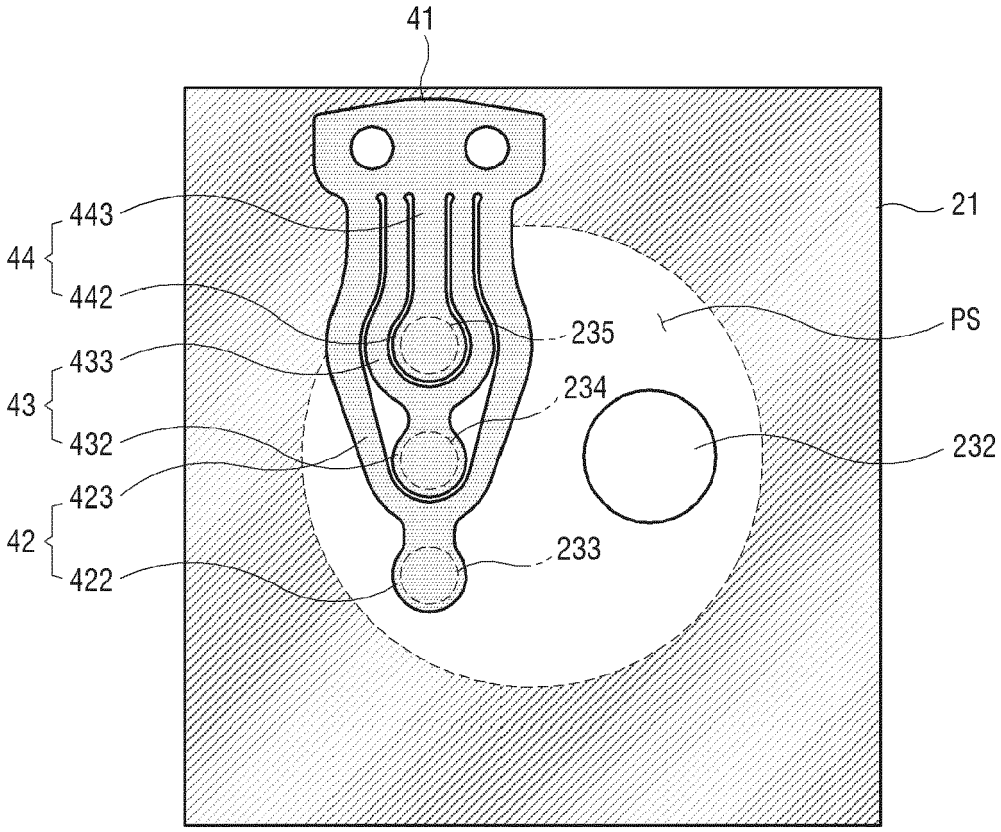
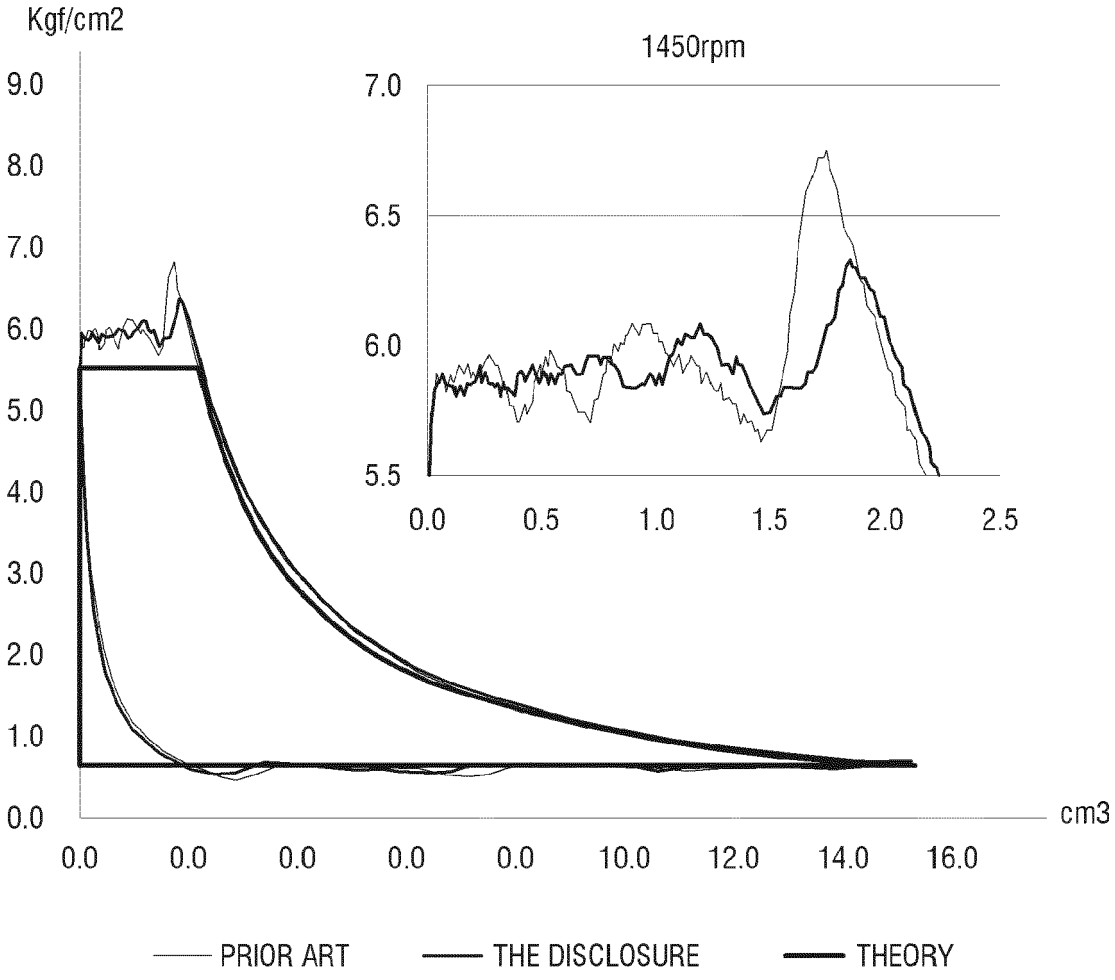


FIG. 10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0.0
0.0
0.0
10.0
12.0
14.0
16.0
cm3
1450rpm
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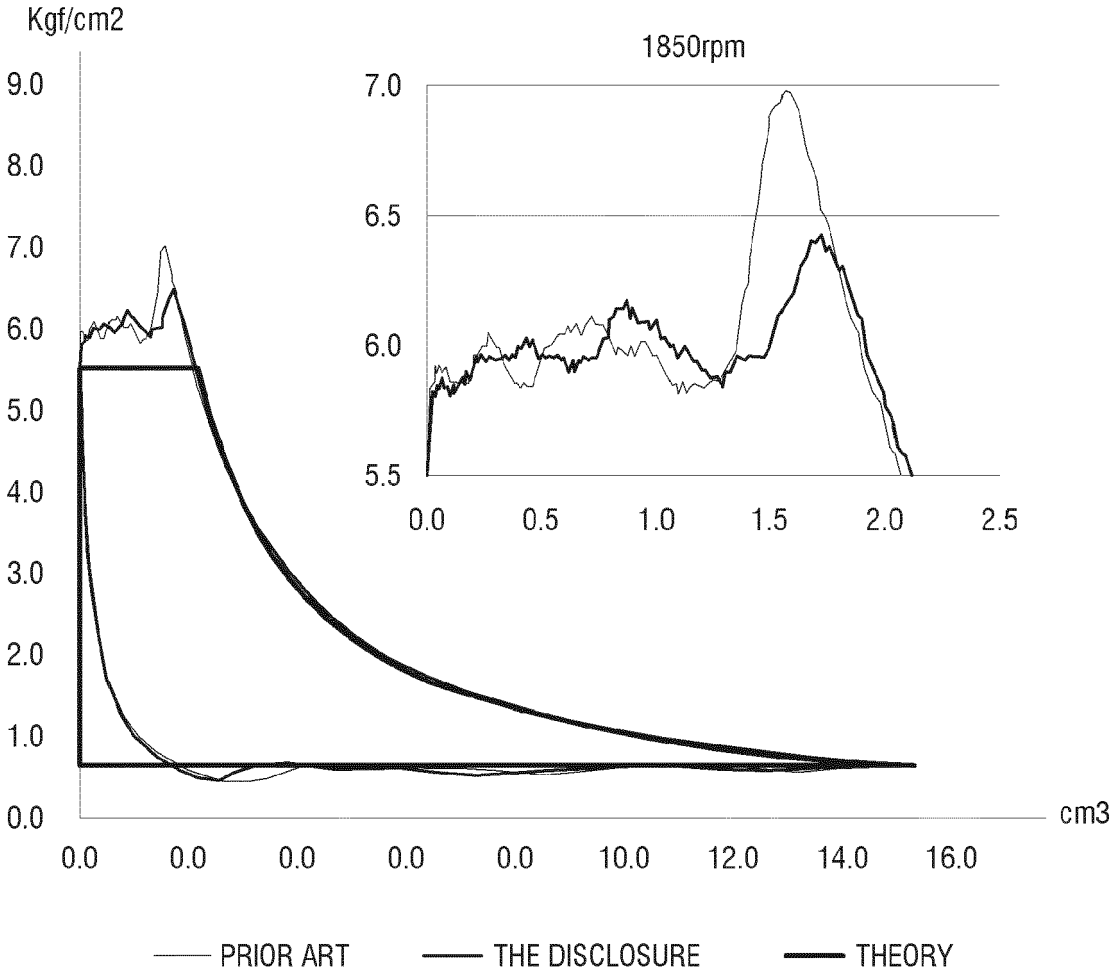
2.0
2.5
PRIOR ART
THE DISCLOSURE
THEORY

FIG. 11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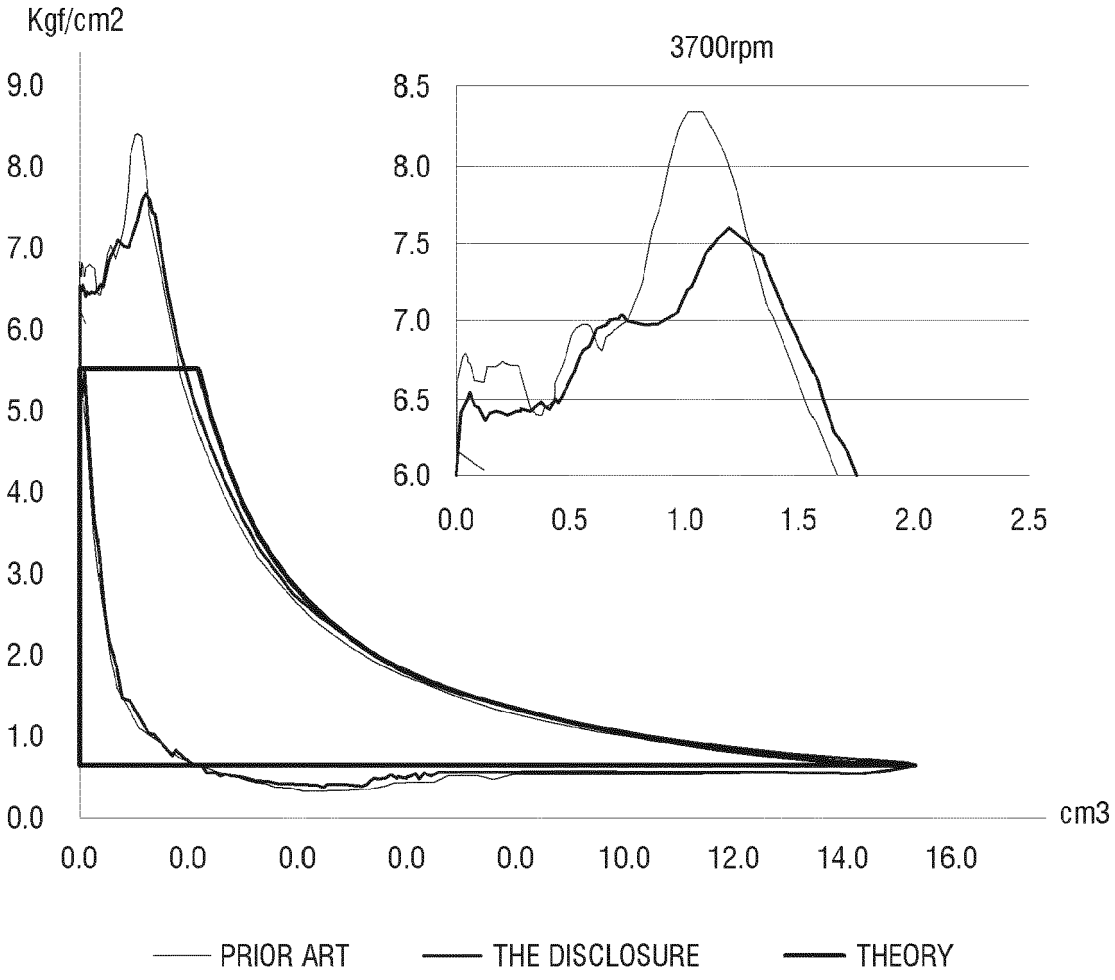
PRIOR ART
THE DISCLOSURE
THEORY

FIG. 12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10.0
12.0
14.0
16.0
cm3
3700rpm
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8.0
7.5
7.0
6.5
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2.5
PRIOR ART
THE DISCLOSURE
THEORY

FIG. 13

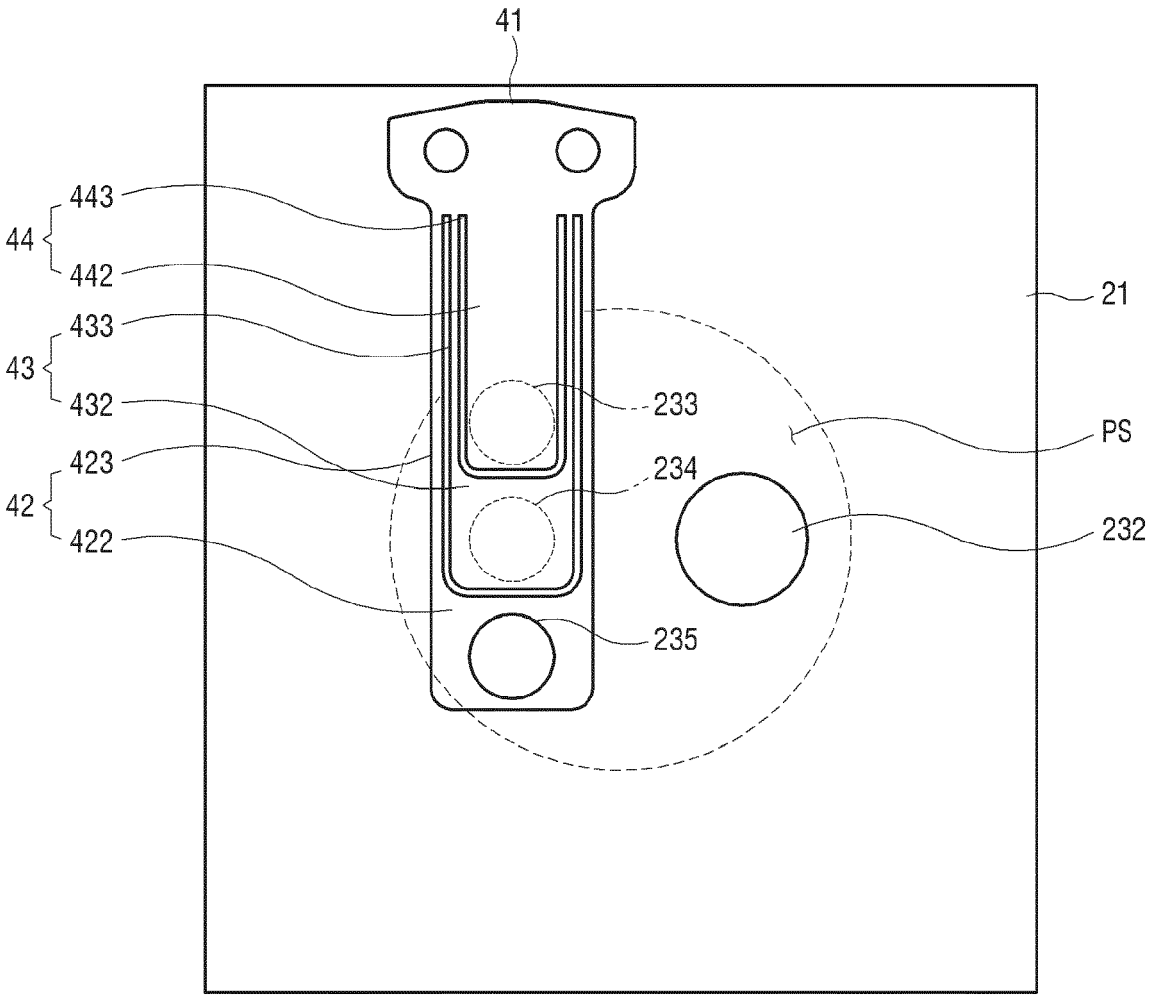


FIG. 14

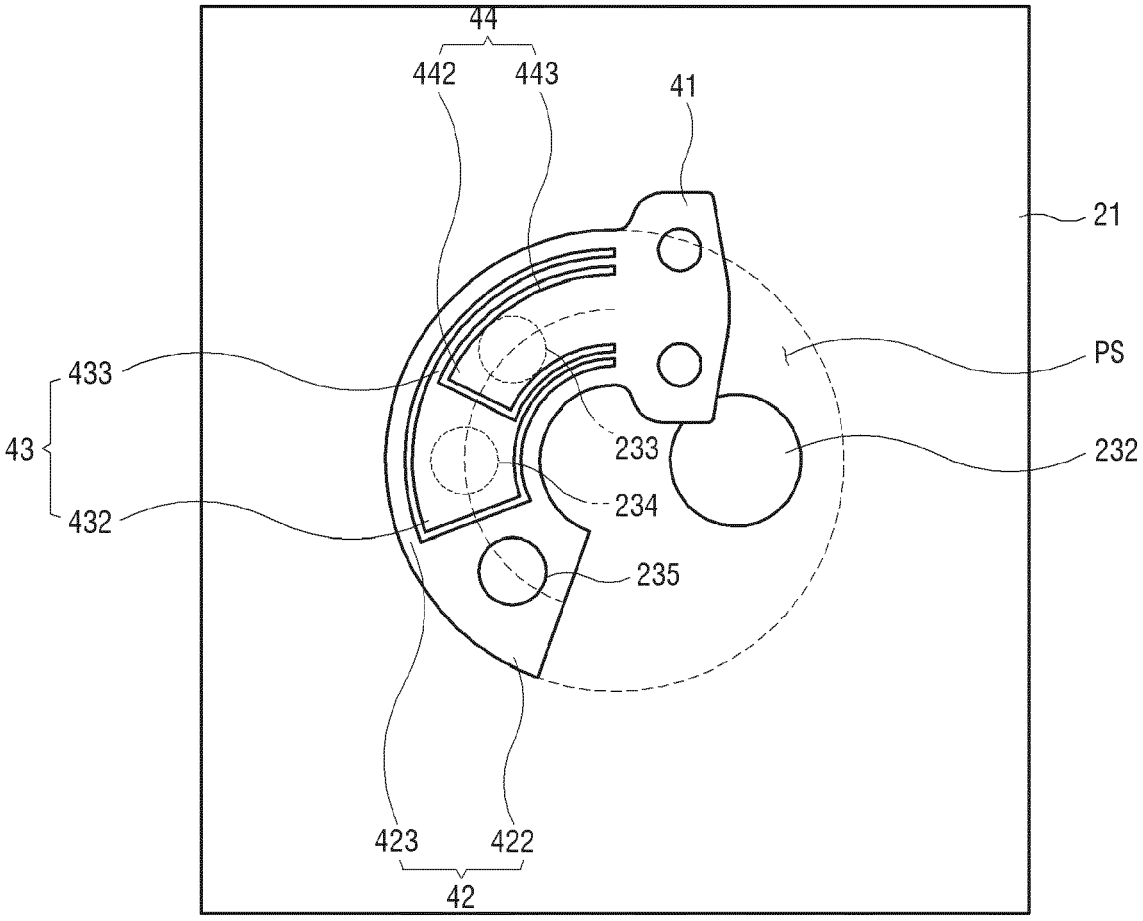


FIG. 15

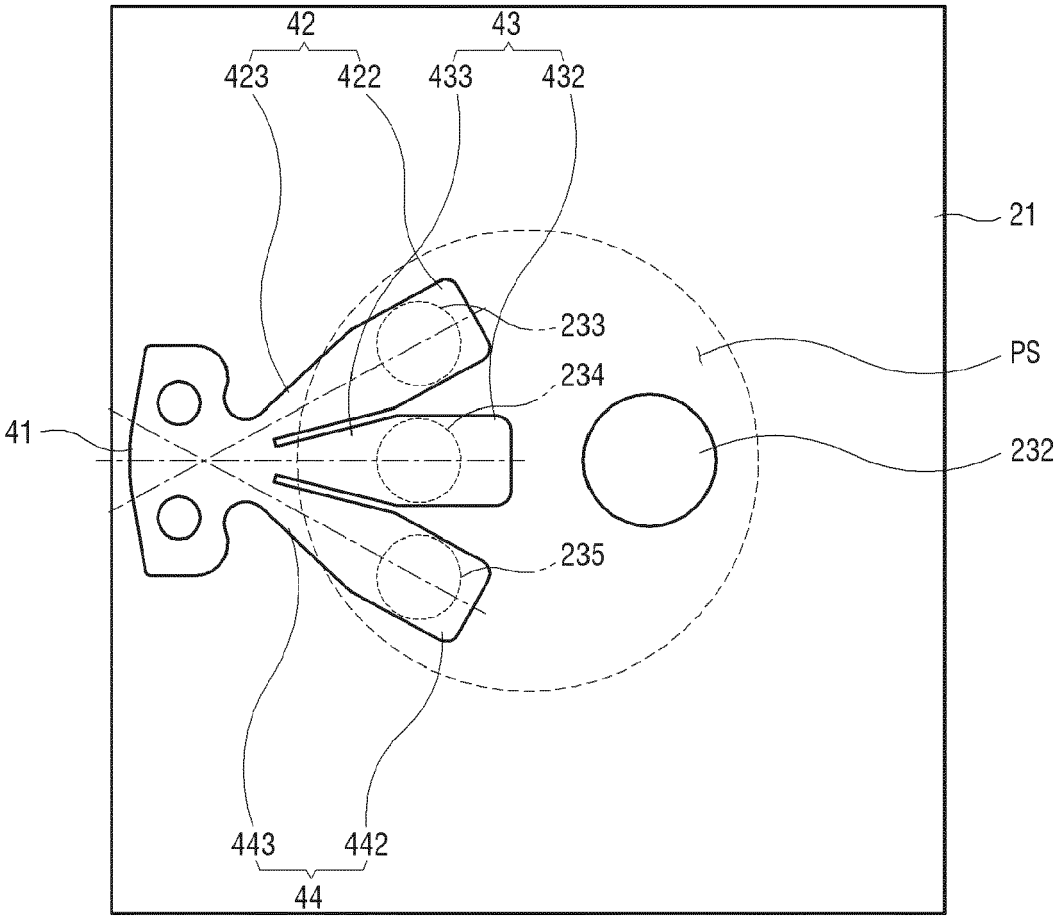
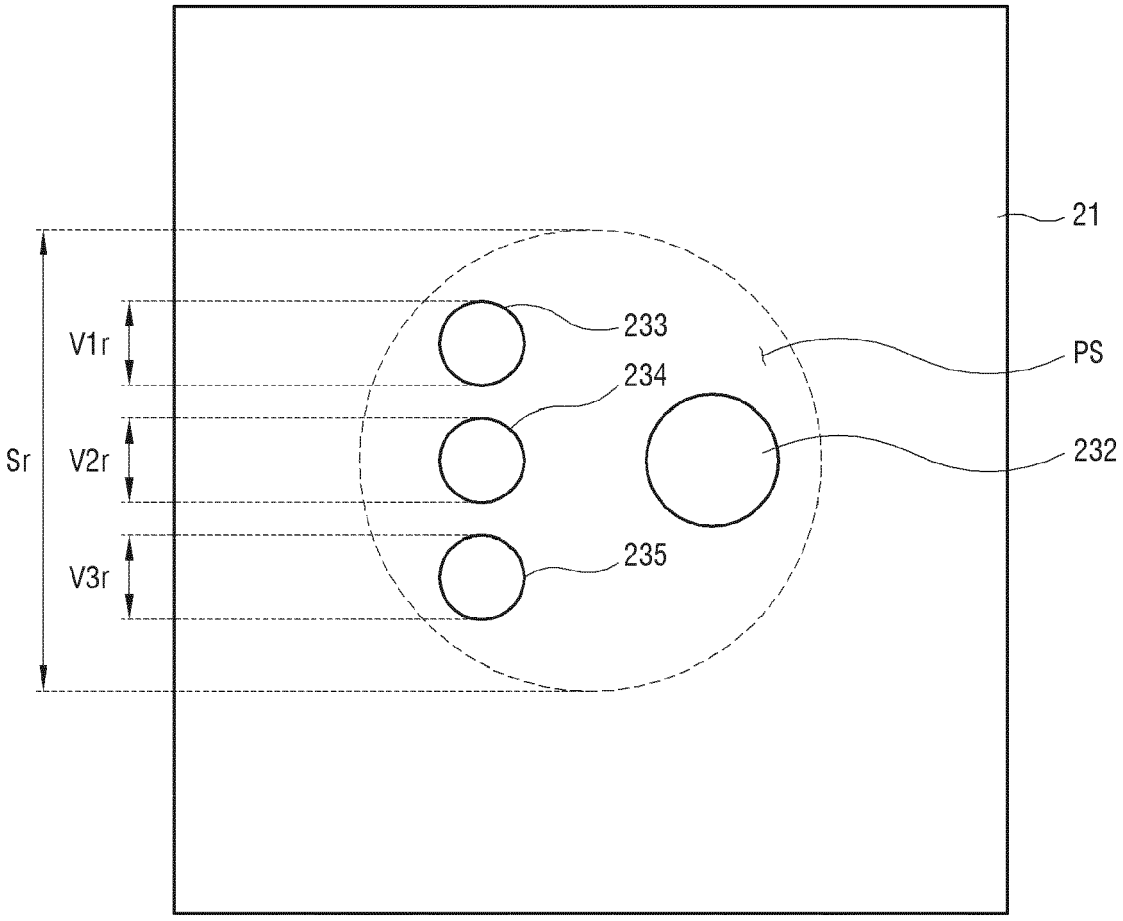


FIG. 16



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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 6164

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 May 2023	Pinna, Stefano

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