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(71) Applicant (for all designated States except US): **YANG, Hea Sook** [KR/KR]; 2nd Floor, 491-23 Daeya-dong, Siheung-si, Gyeonggi-do 429-010 (KR).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **MIN, Byung Il** [KR/KR]; 2nd Floor, 491-23 Daeya-dong, Siheung-si, Gyeonggi-do 429-010 (KR).

(74) Agent: **KIM, Hyo Jeong**; #301, Eunha Bldg., 647-7 Yeoksam-dong, Gangnam-gu, Seoul 135-080 (KR).

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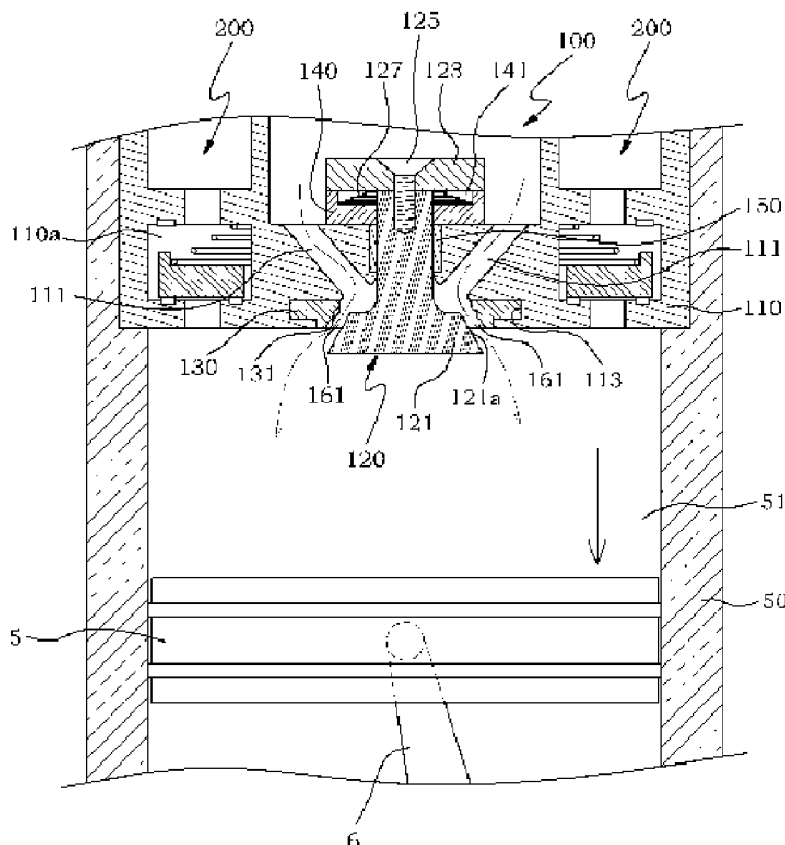
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(54) Title: INTAKE AND EXHAUST VALVES FOR CYLINDER TYPE AIR COMPRESSOR



(57) Abstract: Intake and exhaust valves for a cylinder type air compressor. The intake valve includes a valve body having a plurality of intake ports, a movable shaft elastically installed in the valve body to open and close the intake ports, a packing for elastically supporting the outer surface of a valve head of the movable shaft when the movable shaft is moved upwards and downwards to reduce striking noise, and an elastic support element for elastically supporting the lower end of a stopper. The exhaust valve includes a plurality of exhaust ports defined in the valve body around the intake ports to be arranged in a circumferential arrangement centered around the movable shaft, and a ring-shaped movable opening and closing element elastically supported to open and close the plurality of exhaust ports.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Description

INTAKE AND EXHAUST VALVES FOR CYLINDER TYPE AIR COMPRESSOR

Technical Field

- [1] The present invention relates to intake and exhaust valves for a cylinder type air compressor, and more particularly to intake and exhaust valves for a cylinder type air compressor wherein a plurality of exhaust ports are arranged around a plurality of intake ports so that exhaust heat can be evenly distributed over a cylinder head to prevent compressed air discharged at high temperature from concentrating heat at one portion of the cylinder head, and thereby the durability of the cylinder head is not degraded due to the high temperature exhaust heat, wherein a movable shaft having a predetermined thickness and a ring-shaped movable element are employed to minimize vibration upon the intake and exhaust of air, and wherein a packing having excellent elasticity and airtightness is installed on the portion of the cylinder head on which the valve shaft is seated so as to eliminate a noise source.

Background Art

- [2] As is generally known in the art, a reciprocating type air compressor is used to compress air and store compressed air in a storage tank having a predetermined storage capacity so that various work can be performed using the air stored at high pressure.
- [3] A conventional air compressor comprises a storage tank for storing compressed air. A cylinder block, which has an electric motor and a pulley positioned at one side of the electric motor, is installed on the upper end of the storage tank. A belt transmits the power generated by the electric motor to the pulley. A cylinder head which has an intake valve for sucking air and an exhaust valve for discharging compressed air is installed on the upper end of the cylinder block.
- [4] Referring to FIG. 1, pistons 53a and 53b for sucking and discharging air are disposed in the cylinder block. The pistons 53a and 53b are connected to a crankshaft (not shown) one end of which is connected to the pulley to receive power from the electric motor to thereby be rotated.
- [5] In the conventional air compressor constructed as mentioned above, the power of the electric motor is transmitted via the belt to the pulley which in turn transmits the power to the crankshaft. As a consequence, as the pistons 53a and 53b which are disposed in the cylinder block are reciprocated upwards and downwards, air is sucked through the intake valve 2, is compressed, and is discharged through the exhaust valve 3. The compressed air is stored in the storage tank after passing through a discharge pipe.

- [6] In each of the conventional intake and exhaust valves 2 and 3, a plurality of openings 22 are defined in a valve body 20, and a valve plate 24 for opening and closing the openings 22 is elastically installed with springs 21a and 21b. In the case of the intake valve 2, the valve plate 24 opens and closes the lower ends of the openings 22, and in the case of the exhaust valve 3, the valve plate (not shown) opens and closes the upper ends of the openings (not shown). As the intake valve 2 and the exhaust valve 3 are opened by the suction force and expansion force developed in cylinders 51 and 52 due to the reciprocating movement of the pistons 53a and 53b, air is sucked and discharged.
- [7] After the intake and exhaust valves 2 and 3 are inserted into the cylinder head 4, they are fixed in place by intake-side and exhaust-side holders 26 and 36 which have a plurality of holes 26a and 36a on walls thereof.
- [8] However, in the conventional intake and exhaust valves 2 and 3, since the valve plate 24 is made of a metallic material (such as stainless steel), when sucking and discharging air, as the valve plate 24 is attached to and detached from the valve body 20 having the openings 22, striking noise and vibration are generated. The striking noise and vibration generated in this way are transmitted to an intake port 42 through the holes 26a and then to the outside to increase the total noise of the air compressor.
- [9] In order to cope with this problem, a noise reduction device is adopted in Korean Utility Model Registration No. 359639, in which the valve plate 24 made of a metallic material is replaced with one made of synthetic resin and the structures of the holders 26 and 36 are slightly modified. Nevertheless, even in this device, as an annular plate-shaped valve plate 24 having a small thickness is continuously reciprocated upwards and downwards in each of the intake and exhaust valves, it strikes the lower surface of the valve body 20 in the upper part and against a support 28 in the lower part. Therefore, due to the thin configuration of the valve plate 24, vibration which generates noise, still occurs in the valve plate 24. Also, due to the fact that the valve plate 24 is made of synthetic resin, when compared to the valve plate 24 made of a metallic material, a serious problem is caused in that the durability of the valve plate 24 is markedly degraded.
- [10] Meanwhile, the intake valve and the exhaust valve are arranged on the cylinder head of the conventional air compressor in such a way as to be opposite each other.
- [11] In this case, compressed air, which has high temperature due to compression heat and frictional heat generated in the exhaust stroke, is discharged from the exhaust valve, whereby the portion of the cylinder head on which the exhaust valve is installed is hot. On the contrary, in the portion of the cylinder head on which the intake valve is installed, outside cool air is introduced into the intake valve through an air filter. Thus, while sucking and discharging air, both sides of the cylinder head are exposed to a

substantial temperature difference. That is to say, because heat is concentrated around the exhaust valve, the durability of the cylinder head and the cylinder block is significantly degraded.

Disclosure of Invention

Technical Problem

- [12] Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide intake and exhaust valves for a cylinder type air compressor wherein a plurality of exhaust ports are arranged around a plurality of intake ports so that exhaust heat can be evenly distributed over a cylinder head to prevent compressed air discharged at high temperature from concentrating heat at one portion of the cylinder head, and thereby the durability of the cylinder head is not degraded due to the high temperature exhaust heat, wherein a movable shaft having a predetermined thickness and a ring-shaped movable element are employed to minimize vibration upon the intake and exhaust of air, and wherein a packing having excellent elasticity and airtightness is installed on the portion of the cylinder head on which the valve shaft is seated so as to eliminate a noise source.

Technical Solution

- [13] In order to achieve the above object, according to one aspect of the present invention, there is provided an intake and exhaust valves for a cylinder type air compressor, located in a holder inserted into a cylinder block of the air compressor which has a storage tank, so that, as pistons disposed in the cylinder block are reciprocated upwards and downwards by means of a motor and a pulley connected to the motor, air is sucked and discharged and compressed air is stored in the storage tank, the intake and exhaust valves comprising an intake valve including a valve body which is inserted into the cylinder head and has a plurality of intake ports defined through it and inclined toward a center thereof between upper and lower surfaces thereof, a movable shaft which is elastically installed in the valve body by means of a coil spring and a stopper to be moved upwards and downwards through the center of the valve body and is formed adjacent to a lower end thereof with a valve head for closing and opening the plurality of intake ports when the movable shaft is moved upwards and downwards, a packing which is fitted into a lower end of the valve body and an inner surface of which has an inclination corresponding to that of an outer surface of the valve head of the movable shaft to be brought into close contact with the outer surface of the valve head to thereby maintain airtightness of a cylinder when the intake valve is closed and to elastically support the outer surface of the valve head when the movable shaft is moved upwards and downwards to thereby reduce striking noise, and an elastic

support element which is placed on the upper surface of the valve body to allow the movable shaft to be fitted through a center portion thereof, holds a lower end of the coil spring thereon and elastically supports a lower end of the stopper when the movable shaft is moved upwards and downwards to reduce striking noise; and an exhaust valve including a plurality of exhaust ports which are defined in the valve body around the intake ports to be arranged in a circumferential arrangement centered around the movable shaft, and a ring-shaped movable opening and closing element which is elastically supported to open and close the plurality of exhaust ports.

[14] According to another aspect of the present invention, intake and exhaust through the plurality of intake ports and the plurality of exhaust ports are isolated from each other by a partition wall which is formed on the upper surface of the valve body.

[15] According to another aspect of the present invention, the packing, the movable opening and closing element, and first through third seal rings are made of one selected from the group consisting of graphite, Viton, fluoro rubber, high tension silicon, and aromatic polyamide fiber which have excellent elasticity and airtightness.

[16] According to another aspect of the present invention, the packing of the intake valve is formed on the inner surface thereof with a plurality of protrusions, each of which has a hemispherical shape and an inclined surface to be brought into close contact with the outer surface of the valve head of the movable shaft to thereby maintain airtightness of the cylinder.

[17] According to still another aspect of the present invention, the elastic support element of the intake valve is formed with a plurality of protuberances on the upper end surface thereof in order to reduce striking noise.

[18] According to yet still another aspect of the present invention, the movable shaft of the intake valve is made of a metallic material so as to have improved durability when compared to the conventional valve plate made of synthetic resin.

Advantageous Effects

[19] Thanks to the features of the present invention, advantages are provided in that, since high temperature compressed air is discharged through a plurality of exhaust ports defined along the circumferential direction on a valve body mounted to a cylinder head, it is possible to prevent heat from being concentrated on one portion of the cylinder head and the durability of the cylinder head and a cylinder block from being degraded. Also, noise generated between two parts striking each other during upward and downward reciprocating movement of a movable shaft can be considerably reduced.

Brief Description of the Drawings

[20] FIG. 1 is an exploded perspective view illustrating conventional intake and exhaust

valves for a cylinder type air compressor;

[21] FIG. 2 is a schematic cross-sectional view illustrating intake and exhaust valves for a cylinder type air compressor in accordance with an embodiment of the present invention, which is undergoing an intake stroke;

[22] FIG. 3 is a schematic cross-sectional view illustrating the intake and exhaust valves for a cylinder type air compressor in accordance with the embodiment of the present invention, which is undergoing an exhaust stroke;

[23] FIG. 4 is a plan view illustrating the intake and exhaust valves for a cylinder type air compressor in accordance with the embodiment of the present invention; and

[24] FIG. 5 is an enlarged view of the 'A' part of FIG. 3.

Best Mode for Carrying Out the Invention

[25] Hereafter, a preferred embodiment of the present invention will be described in detail with reference to the attached drawings.

[26] FIG. 2 is a schematic cross-sectional view illustrating intake and exhaust valves for a cylinder type air compressor in accordance with an embodiment of the present invention, which is undergoing an intake stroke, FIG. 3 is a schematic cross-sectional view illustrating the intake and exhaust valves for a cylinder type air compressor in accordance with the embodiment of the present invention, which is undergoing an exhaust stroke, FIG. 4 is a plan view illustrating the intake and exhaust valves for a cylinder type air compressor in accordance with the embodiment of the present invention, and FIG. 5 is an enlarged view of the 'A' part of FIG. 3.

[27] Referring to FIGs. 2 and 3, in the intake and exhaust valves 100 and 200 for a cylinder type air compressor in accordance with the embodiment of the present invention, a valve body 110 is inserted into a cylinder head 4. A plurality of intake ports 111 are defined through the valve body 110 and are inclined toward the center of the valve body 110 between the upper and lower surfaces of the valve body 110.

[28] A movable shaft 120 is installed through the center of the valve body 110 and is capable of being moved upwards and downwards. A stopper 123 is coupled to the upper end of the movable shaft 120 by a fastening bolt 125. The stopper 123 is elastically coupled to the valve body 110 by way of a conical coil spring 127 which is placed between the stopper 123 and the valve body 110.

[29] When the movable shaft 120 is moved upwards and downwards, it closes and opens the plurality of intake ports 111 through the valve head 121 which is projectedly formed on the lower end of the movable shaft 120.

[30] The lower end of the coil spring 127 is supported by an elastic support element 140. The elastic support element 140 is placed on the upper surface of the valve body 110, and the movable shaft 120 extends through the elastic support element 140.

Concretely speaking, the lower end of the coil spring 127 is received in a groove 141 which is defined on the elastic support element 140.

[31] Referring to FIG. 5, the elastic support element 140 is defined on the upper end surface thereof with a plurality of protuberances 143. The protuberances 143 elastically support the lower end of the stopper 123 when the movable shaft 120 is moved upwards and downwards, thereby reducing striking noise. Preferably, the elastic support element 140 is made of rubber.

[32] A fitting groove 113 is defined on the lower end surface of the valve body 110. A packing 130 is fitted into the fitting groove 113. The inner surface of the packing 130 has an inclination corresponding to that of the outer surface 121a of the valve head 121 of the movable shaft 120 to be brought into close contact with the outer surface 121a of the valve head 121 when the intake valve 100 is closed, to thereby maintain the airtightness of a cylinder 50. The packing 130 elastically supports the outer surface 121a of the valve head 121 when the movable shaft 120 is moved upwards and downwards, in order to reduce striking noise.

[33] A plurality of hemispherical protrusions 131 are formed on the inner surface of the packing 130 to be brought into close contact with the outer surface 121a of the valve head 121 of the movable shaft 120. The protrusions 131 function to minimize the area over which the packing 130 comes into contact with the outer surface 121a of the valve head 121 to thereby reduce striking noise. Each of the protrusions 131 may be formed to have an inclined surface.

[34] The packing 130 is made of graphite, which is a refined natural crystalline graphite product prepared without using any additives and which can maintain heat resistance, flexibility, compression restoration force, and airtightness at high temperature, or fluoro rubber or Viton, which has excellent elasticity at high temperature.

[35] The movable shaft 120 is made of metal or a material which has durability corresponding to that of the metal. Therefore, when compared to the conventional valve plate made of synthetic resin, the movable shaft 120 has improved durability.

[36] In the intake valve 100 constructed as mentioned above, when sucking air, as shown in FIG. 2, as a piston 5 moves downwards and pressure in the cylinder 50 decreases, the movable shaft 120 which is closing the intake ports 111 of the valve body 110 is moved downward, whereby an intake path 161 through which air can be introduced into the cylinder 50 is created.

[37] At this time, while the lower end of the stopper 123 which is moving downwards strikes the upper end surface of the elastic support element 140, since the stopper 123 is elastically supported by the plurality of protuberances 143, striking noise can be significantly reduced.

[38] Then, as the piston 5 moves upwards and the pressure in the cylinder 50 increases,

the movable shaft 120 is moved upward and closes the intake ports 111 again. At this time, as the movable shaft 120 is returned to its original position, when the valve head 121 of the movable shaft 120 strikes the packing 130, striking noise is significantly reduced due to the presence of the plurality of protrusions 131 having a desired degree of elasticity.

[39] Describing the structure of the exhaust valve 200 according to the present invention, referring to FIGs. 3 and 4, a plurality of exhaust ports 211 are defined in the valve body 110 around the intake ports 111 to be arranged in a circumferential arrangement centered around the movable shaft 120.

[40] A ring-shaped movable opening and closing element 220 for opening and closing the plurality of exhaust ports 211 is elastically supported by a coil spring 227 below the exhaust ports 211.

[41] In the construction of the present invention, intake and exhaust through the plurality of intake ports 111 and the plurality of exhaust ports 211 are isolated from each other by a partition wall 300 which is formed on the upper surface of the valve body 110. That is to say, when sucking air into the cylinder 50, air introduced through an air filter is guided into the plurality of intake ports 111, and when discharging air out of the cylinder 50, compressed air which is discharged through the plurality of exhaust ports 211 from the inside space 51 of the cylinder 50 flows through a single exhaust passage (not shown).

[42] First and second seal rings 231 and 232 having different diameters are arranged inward of the exhaust ports 211 at an interval which is less than the widthwise thickness of the movable opening and closing element 220. Similarly to the packing 130, the first and second seal rings 231 and 232 and the movable opening and closing element 220 are made of one selected from the group consisting of graphite, which is a refined natural crystalline graphite product prepared without using any additives and which can maintain heat resistance, flexibility, compression restoration force, and airtightness at high temperature, or fluoro rubber or Viton, which has excellent elasticity at high temperature, high tension silicon, and aromatic polyamide fiber.

[43] By this fact, when the movable opening and closing element 220 closes exhaust paths 261, airtightness can be reliably maintained, and striking noise generated when the movable opening and closing element 220 is moved upward and downward to open and close the exhaust paths 261 can be minimized.

[44] A third seal ring 233 which faces the upward projection 220a of the movable opening and closing element 220 is positioned adjacent to the lower end of the exhaust ports 211 on which the upper end of the coil spring 227 is supported. The third seal ring 233 functions to elastically support the upward projection 220a when the movable opening and closing element 220 is moved upward and downward, whereby the

generation of striking noise can be minimized. It is preferred that the third seal ring 233 be made of the same material as the first and second seal rings 231 and 232.

[45] In this case, it is of course possible that a plurality of protuberances are formed on the upper end surface of the upward projection 220a similarly to the elastic support element 140 shown in FIG. 5 to minimize noise generation.

[46] Preferably, the movable opening and closing element 220 has a width which is slightly less than the width of a chamber 110a such that the compressed air which is discharged through the exhaust paths 261 opened upon exhaust can reliably flow to the exhaust ports 211 after passing through the chamber 110a. Therefore, the compressed air discharged through the exhaust paths 261 is introduced into the exhaust ports 211 through a space defined between the chamber 110a and the inner and outer surfaces of the movable opening and closing element 220.

[47] Hereafter, operation of the intake and exhaust valves for a cylinder type air compressor according to the present invention, constructed as mentioned above, will be described.

[48] First, when sucking air, as the piston 5 is moved downward by an arm 6 and the pressure inside the space 51 of the cylinder 50 decreases, the movable shaft 120 is moved downward and the intake path 161 is created, as a result of which the intake ports 111 are opened.

[49] Then, air introduced through the air filter (not shown) sequentially passes through the intake ports 111 and the intake path 161 to enter the space 51 of the cylinder 50.

[50] Thereafter, as the piston 5 is moved upward and the movable shaft 120 is moved upward, the intake ports 111 are closed and the volume of the space 51 in the cylinder 50 is decreased. In this way, the air having entered the space 51 of the cylinder 50 is compressed. At this time, the air is hot due to compression heat and frictional heat generated between the piston 5 and the inner surface of the cylinder 50.

[51] As the pressure inside the space 51 of the cylinder 50 increases, the movable opening and closing element 220 which is elastically supported by the coil spring 227 is moved upward. At the same time, the plurality of exhaust paths 261 are opened, and the air compressed in the cylinder 50 and having high temperature is discharged sequentially through the exhaust paths 261, the chamber 110a and the exhaust ports 211.

[52] Accordingly, in the present invention, due to the fact that the intake ports 111 and the exhaust ports 211 are arranged in the circumferential direction on the upper surface of the valve body 110, heat can be evenly distributed over the entire area of the valve body 110. Therefore, it is possible to prevent heat of compressed air from being concentrated on one portion of the cylinder head. As a consequence, thermal fatigue induced in the cylinder head can be decreased, and durability of the cylinder head and the cylinder block can be improved.

Industrial Applicability

- [53] As is apparent from the above descriptions, the intake and exhaust valves for a cylinder type air compressor according to the present invention provide advantages in that, since high temperature compressed air is discharged through a plurality of exhaust ports defined along the circumferential direction on a valve body mounted to a cylinder head, it is possible to prevent heat from being concentrated on one portion of the cylinder head and the durability of the cylinder head and a cylinder block from being degraded. Also, noise generated between two parts striking each other during upward and downward reciprocating movement of a movable shaft can be considerably reduced.
- [54] Although preferred embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claim.

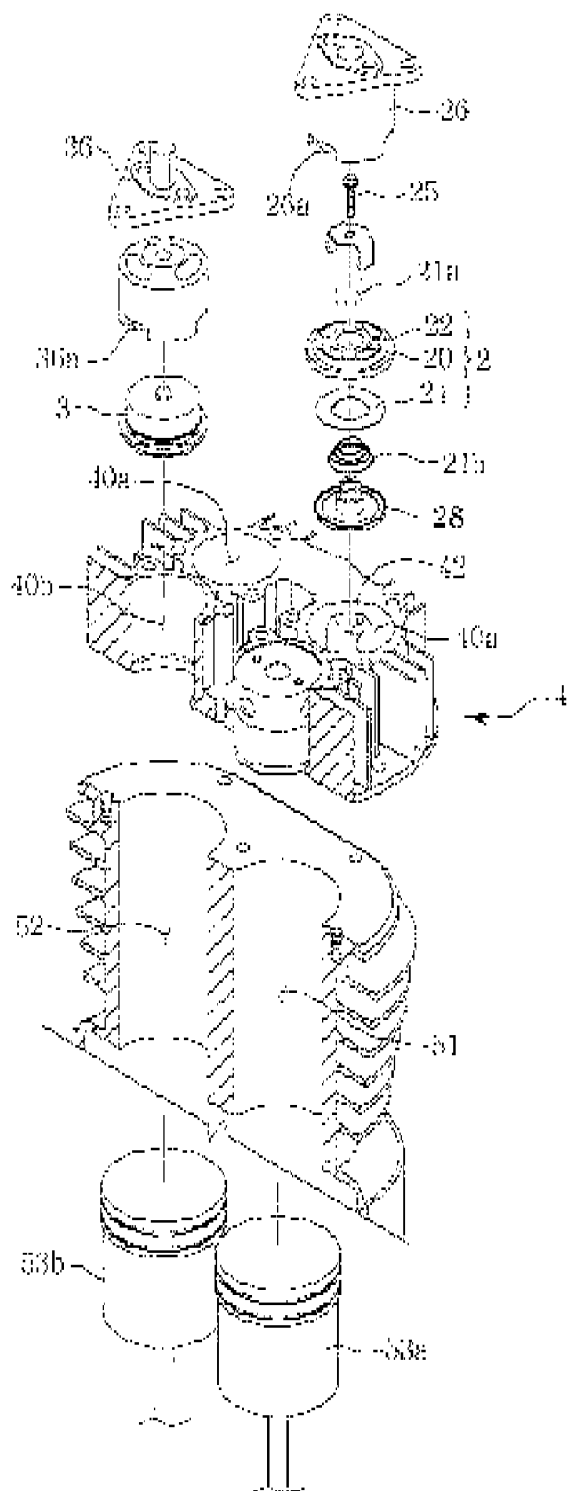
Claims

- [1] Intake and exhaust valves for a cylinder type air compressor, located in a holder inserted into a cylinder block of the air compressor which has a storage tank, so that, as pistons disposed in the cylinder block are reciprocated upwards and downwards by means of a motor and a pulley connected to the motor, air is sucked and discharged and compressed air is stored in the storage tank, the intake and exhaust valves comprising:
- an intake valve including a valve body which is inserted into the cylinder head and has a plurality of intake ports defined through it and inclined toward a center thereof between upper and lower surfaces thereof, a movable shaft which is elastically installed in the valve body by means of a coil spring and a stopper to be moved upwards and downwards through the center of the valve body and is formed adjacent to a lower end thereof with a valve head for closing and opening the plurality of intake ports when the movable shaft is moved upwards and downwards, a packing which is fitted into a lower end of the valve body and an inner surface of which has an inclination corresponding to that of an outer surface of the valve head of the movable shaft to be brought into close contact with the outer surface of the valve head to thereby maintain airtightness of a cylinder when the intake valve is closed and to elastically support the outer surface of the valve head when the movable shaft is moved upwards and downwards to thereby reduce striking noise, and an elastic support element which is placed on the upper surface of the valve body to allow the movable shaft to be fitted through a center portion thereof, holds a lower end of the coil spring thereon and elastically supports a lower end of the stopper when the movable shaft is moved upwards and downwards to reduce striking noise; and
- an exhaust valve including a plurality of exhaust ports which are defined in the valve body around the intake ports to be arranged in a circumferential direction while centering around the movable shaft, and a ring-shaped movable opening and closing element which is elastically supported to open and close the plurality of exhaust ports.
- [2] The intake and exhaust valves according to claim 1, wherein intake and exhaust through the plurality of intake ports and the plurality of exhaust ports are isolated from each other by a partition wall which is formed on the upper surface of the valve body.
- [3] The intake and exhaust valves according to claim 1, wherein the packing, the movable opening and closing element, and first through third seal rings are made of one selected from the group consisting of graphite, Viton, fluoro rubber, high

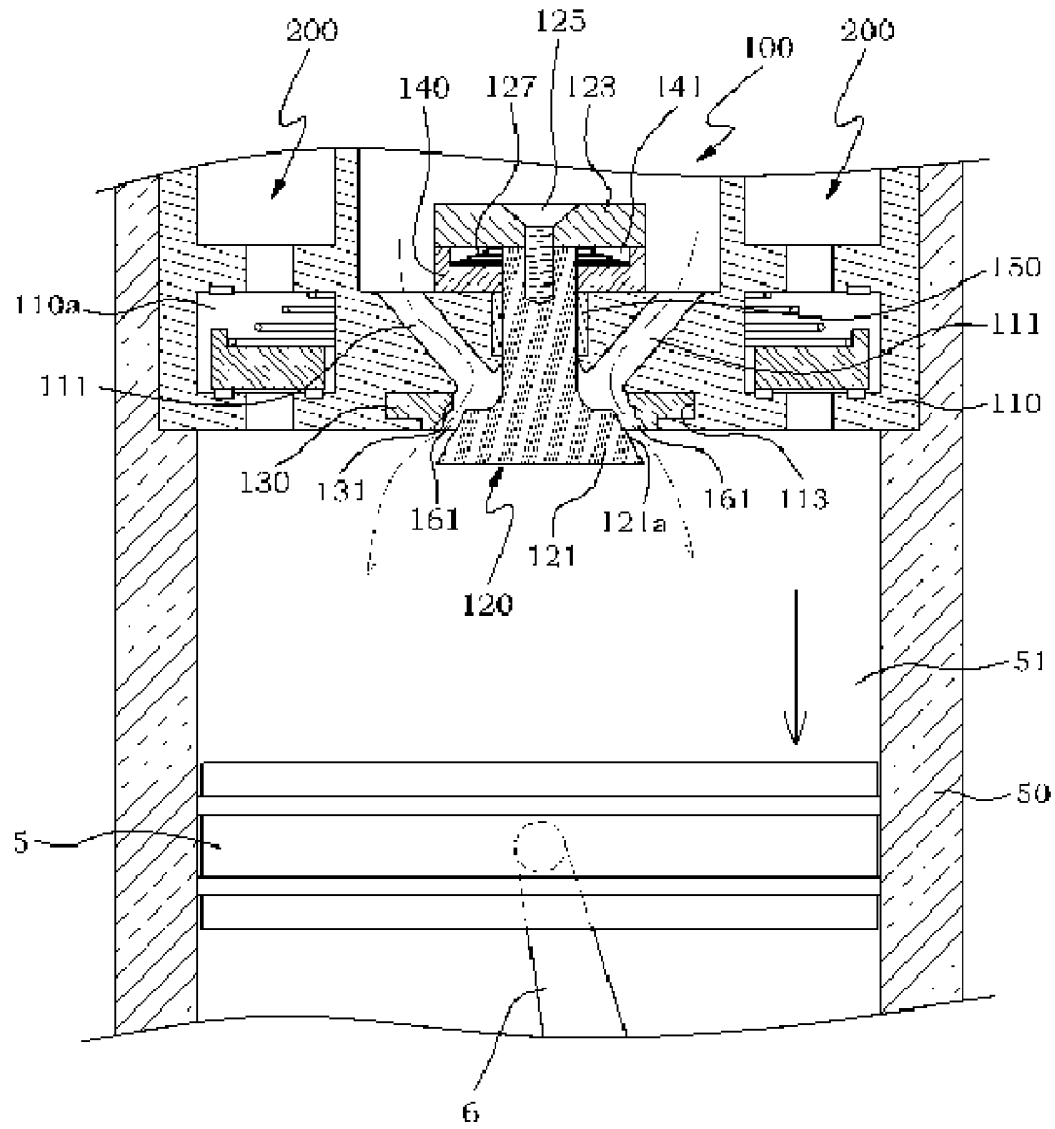
tension silicon, and aromatic polyamide fiber, which have excellent elasticity and airtightness at high temperature.

- [4] The intake and exhaust valves according to claim 1, wherein the packing of the intake valve is formed on the inner surface thereof with a plurality of protrusions, each of which has a hemispherical shape and an inclined surface so as to be brought into close contact with the outer surface of the valve head of the movable shaft, to thereby maintain airtightness of the cylinder.
- [5] The intake and exhaust valves according to claim 1, wherein the elastic support element of the intake valve is formed with a plurality of protuberances on an upper end surface thereof.
- [6] The intake and exhaust valves according to claim 1, wherein the movable shaft of the intake valve is made of a metallic material.

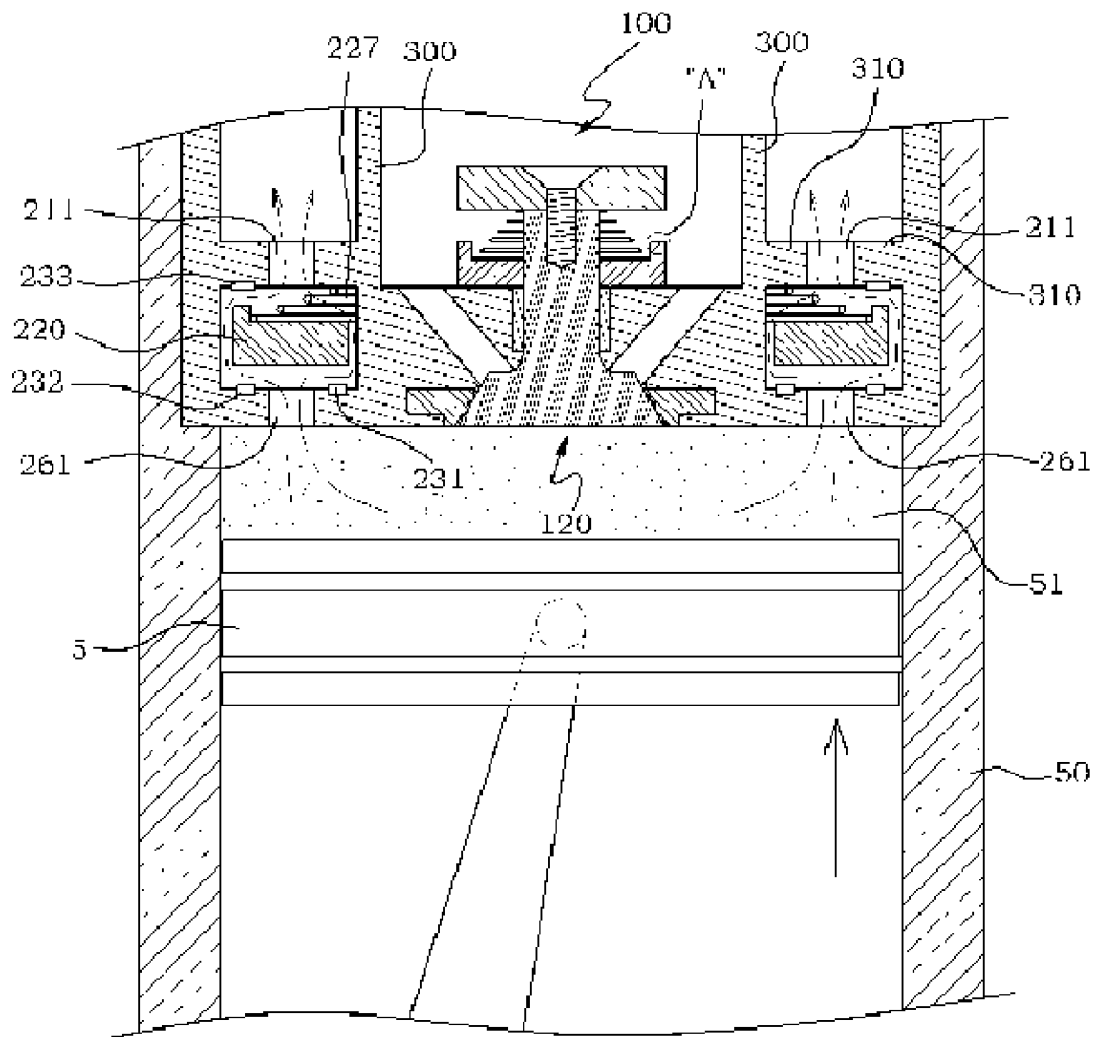
[Fig. 1]



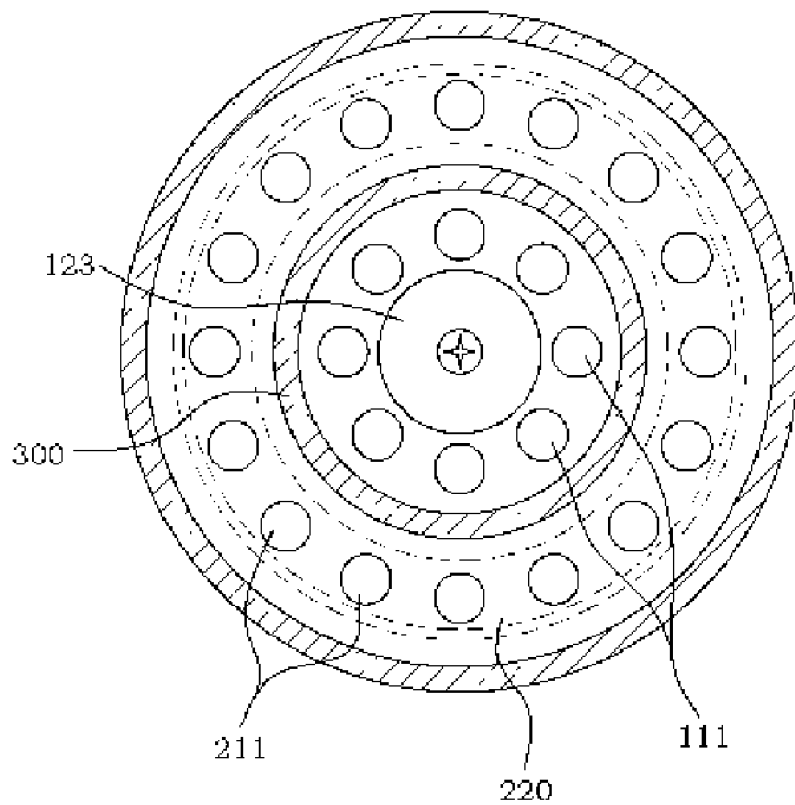
[Fig. 2]



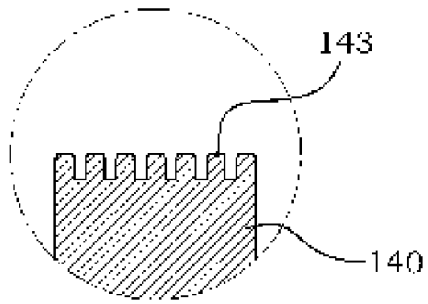
[Fig. 3]



[Fig. 4]



[Fig. 5]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/001441**A. CLASSIFICATION OF SUBJECT MATTER*****F04B 53/10(2006.01)i***

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)

IPC 8 : F04B 53/10, F16K 15/06,

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR, JP, US : classes as IPC8 as above

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and application for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

KIPO eKIPASS system

"compressor <and> valve <and> seal <and> spring"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 2005-129267 A(MIN, BYEONG ILL) 24.03.2005 See Claims 1-5, Figs 2-5	1 - 6
Y	US 6648010 B1(Goodwin International Limited) 18.11.2003 See Columns3 lines 49 -Columns5 lines 35, Figs 1-8	1 - 6
A	US 6719003 B2(Visteon Global Technologies, Inc.) 13.04.2004 See Columns4 lines 44 -Columns5 lines 47, Figs 4-8	1
A	JP 2004-340007 A(TOYOTA INDUSTRIES CORP) 02.12.2004 See Pages4 7, Figs 3-9	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"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

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Date of the actual completion of the international search

19 JULY 2006 (19.07.2006)

Date of mailing of the international search report

21 JULY 2006 (21.07.2006)

Name and mailing address of the ISA/KR

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SHIM, Jae Man

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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