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(54) **AIR COMPRESSOR CYLINDER, AIR COMPRESSOR, VEHICLE SEAT, AND VEHICLE**

(57) The invention relates to an air compressor cylinder, an air compressor, an automobile seat and an automobile. The air compressor cylinder is suitable for a piston type air compressor, a cavity is defined in a cylinder

block of the cylinder, a liner is attached to an inner sidewall of the cavity, the liner is securely bonded to the inner sidewall, and the liner defines a compression cavity of the air compressor.

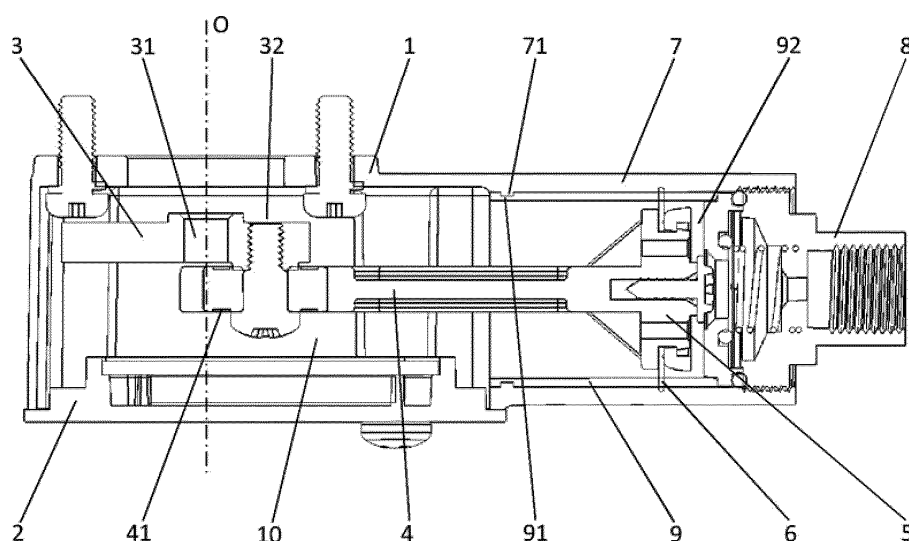


Fig. 2

Description

FIELD OF THE INVENTION

[0001] The invention relates to the technical field of air compressors; specifically, the invention relates to an air compressor cylinder, an air compressor comprising the air compressor cylinder, and further relates to an automobile seat and an automobile comprising such air compressor.

BACKGROUND OF THE INVENTION

[0002] Air compressors are used in multiple places in modern automobiles as driving or braking apparatus. For example, a piston type air compressor is employed in some automobile seats for adjustment of moving, lumbar support and the like thereof.

[0003] The piston type air compressor is a positive displacement compressor, the compression element thereof comprises a piston, the piston reciprocates in the cylinder thereby operating by way of causing the working volume to constantly change. As can be seen, the manufacturing of the piston and cylinder has a direct effect on the operating performance of the air compressor.

[0004] FIG. 1 is a schematic view of a piston type air compressor in the prior art. Such piston type air compressor has a driving portion 100 and an air compression execution portion 200. The driving apparatus internal to the driving portion 100 may be a motor or the like, and a piston and a cylinder are disposed at the compression execution portion 200.

[0005] The Patent Application Publication No. WO2004/011804A1 of VENTREX AUTOMOTIVE GMBH, discloses an improvement to the piston structural design in a piston type air compressor.

[0006] For cylinder block manufacturing of the cylinder, commonly the prior art mainly comprises two modes: one is to machine a cylinder block firstly, and then connect the cylinder block with the outer housing of the air compressor; another is to produce the outer shell (including the cylinder) of the air compressor through die-casting molding, so that the processing requirement for the cylinder block is directly achieved.

SUMMARY OF THE INVENTION

[0007] It is an object of one aspect of the present invention to provide an improved air compressor cylinder.

[0008] It is an object of another aspect of the present invention to provide an air compressor comprising the foregoing cylinder.

[0009] It is an object of yet another aspect of the present invention to provide an automobile seat and an automobile comprising the foregoing air compressor.

[0010] To achieve the foregoing object, a first aspect of the present invention provides a cylinder for a piston type air compressor, wherein a cavity is defined in a cyl-

inder block of the cylinder, a liner is attached to an inner sidewall of the cavity, the liner is securely bonded to the inner sidewall, and the liner defines a compression cavity of the air compressor.

[0011] Optionally, in the cylinder as previously described, a smoothness of an inner surface of the liner is greater than the smoothness of a surface of the cylinder block itself.

[0012] Optionally, in the cylinder as previously described, the liner is die cast together with the cylinder block.

[0013] Optionally, in the cylinder as previously described, securing between the liner and the cylinder block is achieved by a threaded connection.

[0014] Optionally, in the cylinder as previously described, the inner sidewall of the liner is in a straight cylindrical shape, and shape and size of a cross-section of the liner at both ends are the same.

[0015] Optionally, in the cylinder as previously described, the liner is a deep drawn tube made of aluminum or aluminum alloy.

[0016] Optionally, in the cylinder as previously described, the cylinder is die cast by zinc or zinc alloy with the liner.

[0017] To achieve the foregoing object, a second aspect of the present invention provides a piston type air compressor, wherein a cylinder of the air compressor is the cylinder of any of the foregoing first aspects.

[0018] To achieve the foregoing object, a third aspect of the present invention provides an automobile seat, wherein the piston type air compressor of the foregoing second aspect is provided in the automobile seat.

[0019] To achieve the foregoing object, a fourth aspect of the present invention provides an automobile, wherein the automobile is provided with the piston type air compressor of the foregoing second aspect, and/or the automobile is provided with the automobile seat of the foregoing third aspect.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The disclosure of the present invention will become more apparent with reference to the accompanying drawings. It should be understood that these drawings are for illustrative purposes only and are not intended to limit the protective scope of the present invention. In the drawings:

FIG. 1 is a schematic view of a piston type air compressor of the prior art; and

FIG. 2 is a schematic view of a cylinder-piston mechanism of an air compressor according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENT(S) OF THE INVENTION

[0021] Specific embodiments of the invention are illustrated in detail below with reference to the accompanying drawings. In the drawings, like reference numerals designate like or corresponding technical features, and the drawings are not necessarily drawn to scale.

[0022] FIG. 2 is a schematic view of a cylinder-piston mechanism of an air compressor according to one embodiment of the present invention.

[0023] Also shown in the illustrated embodiment is a housing 1 of an air compressor that, along with a housing cover 2, collectively constitutes a chamber 10, within which a crank 3 and a piston 5 connected with a push rod 4 may be housed. An integral cylinder 7 is formed at one end of the housing 1. A cylinder block as a body part of the cylinder 7 is used for forming a compression cavity, and a sealing ring 6 is disposed on the piston 5 and fits within the cylinder block part of the cylinder 7. The cylinder 7 is connected at the end with an air outlet 8.

[0024] To facilitate assembly and disassembly of the various internal components of the chamber 10, such as the crank 3, the push rod 4, and the piston 5, the housing cover 2 and the air outlet 8 are secured to the housing 1 in a removable manner. For example, they may be threaded or snapped onto the housing 1. In the illustrated embodiment, the air outlet 8 is in threaded connection with one end portion of the cylinder 7. It will be understood that the manner of connection in the illustrated embodiments is exemplary only.

[0025] The center hole 31 of the crank 3 in the figure is adapted to be connected on a drive shaft of a drive motor (not shown). The opposite end of the push rod 4 from the position of the piston 5 may be connected to the eccentric hole 32 of the crank 3. It should be noted that the connection of the push rod 4 at the eccentric hole 32 is an movable connection, for example, a bearing 41 may be disposed at this end of the push rod 4 to reduce rotational resistance.

[0026] The piston 5 may be secured at the other end of the push rod 4, and a sealing ring 6 may be disposed on the outer periphery of the piston 5, and the piston 5 will reciprocate with the push rod 4 to change the volume of the compression cavity 71. The presence of the sealing ring 6 prevents excessive gas leakage from the compression cylinder toward the rear of the piston 5.

[0027] Specifically, in accordance with the illustrated embodiment, when the air compressor is operating, the motor drives the crank 3 to rotate along the axis O, and one end of the push rod 4 rotates with the eccentric hole 32 of the crank 3, the other end connected to the piston 5 push the piston 5 to reciprocate within the cylinder 7 and change the volume of the compression cavity. When the air volume of the compression cavity decreases, the gas is discharged from the air outlet 8 to be used for different purposes depending on different applications.

[0028] It may also be seen from the illustrated embod-

iment, a liner 9 is attached to the inner wall at the cylinder block portion defining a cavity within the cylinder 7. It should be further illustrated herein that while the cylinder 7 is an integral part of the housing 1 of the air compressor in the illustrated embodiment, it is not necessary for the cylinder to have an integrally molded housing; the cylinder 7 may absolutely be manufactured separately in other embodiments and then secured to housing 1 in an appropriate manner. These appropriate manners include, but not limited to, various existing manners such as threading, snapping, welding, gluing, and the like. In an additional optional embodiment, the housing 1 may also be die cast onto the cylinder 7 after separate manufacturing of the cylinder 7.

[0029] In an optional embodiment, the liner 9 may be made of a different material than the cylinder block portion of the cylinder 7. The liner 9 may be made independently of the cylinder 7, the manufacturing method of which may also be different from the cylinder 7. For example, in an optional embodiment, the liner 9 may be a deep drawn tube made of aluminum or aluminum alloy; while the cylinder 7 may be cast, for example, the cylinder may be die cast by zinc or zinc alloy with a manufactured liner, i.e., a secondary injection molding using aluminum or an aluminum alloy within the zinc mold, thereby the aluminum can have a smoother surface than the die cast zinc or zinc alloy. Achieving a smooth surface by polishing the die cast zinc or zinc alloy parts is costly.

[0030] In an optional embodiment, the cylinder 7 may be integrally cast with the housing 1 of the air compressor.

[0031] The liner 9 may be securely bonded to the inner sidewall of the cavity within the cylinder 7 in an appropriate manner. In an optional embodiment, the liner 9 may be connected to the inner sidewall by threads; specifically, matched threads may be formed on the outer sidewall of the liner 9 and the inner sidewall of the cavity to perform engagement, such bonding manner has flexibility, may separately replace the liner 9 when needed, and is advantageous for maintenance and extending the service life of the product. In the illustrated embodiment, the cylinder 7 (or along with the housing 1) may be die cast together with the liner 9 after the inner liner 9 is made; it is also possible to have a shape mating at the same time, for example, a protrusion 71 is formed on the inner sidewall of the cylinder block, bonded into a recess 91 on the outer sidewall of the liner 9, further enhancing axial position-limiting performance of the two. It may be appreciated that the protrusion 71 and the recess 91 may extend over the entire circle respectively in a respective circumferential direction; they may also distribute dispersedly in a circumferential direction thereby also enhancing the circumferential position limiting performance of the two. In additional embodiments, it may also be considered to use structural adhesive to adhere the cylinder and the liner together.

[0032] Overall considering the various embodiments described above, as the liner 9 may be separately manufactured and then bonded into the cylinder 7, this facil-

itates machining of the inner surface of the liner 9 in a low cost manner to achieve higher surface precision, i.e., smoothness, reducing the difficulty of the process, and make the defect rate easy to be controlled.

[0033] As can be seen from the figure, the liner 9 defines a compression cavity 92 of the air compressor. It can be seen that it will be easy to, by independent process in advance, make the smoothness of the inner surface of the inner liner 9, i.e., the compression cavity, be able to be at least greater than the surface smoothness of the cylinder's cylinder block itself. Such improvement of the smoothness of the inner surface of the compression cavity effectively increases the service life of the air compressor, significantly increases the number of working cycles, improves the working efficiency, reduces the production cost, and can avoid the high local performance requirements of the material of the molded part.

[0034] Such separately manufactured liner may be machined from deep drawn tube having the advantage that the inner sidewalls of the compression cavities no longer have draft angles like in casting. Specifically, in an optional embodiment, the inner sidewall of such separately manufactured liner may be in a straight cylindrical shape, and the shape and size of the cross-section of the liner at both ends are the same. Due to the elimination of draft angle, this straight cylindrical design is advantageous for increasing the degree of matching of the piston within the compression cavity, avoiding the degradation of its performance and durability due to the friction and angle of the inner sidewalls of the compression cavity, and making the product more compact and make the work efficiency higher.

[0035] Another aspect of the invention also provides a piston type air compressor, wherein the cylinder of the air compressor is the cylinder of any of the foregoing embodiments. It is discovered in one aspect of the present invention, using separately manufactured liner in a cylinder of a piston type air compressor can not only increase the flexibility of cylinder manufacturing and air compressor manufacturing, but also makes it easy to achieve higher surface precision inside the liner when the liner is manufactured separately, improves the working efficiency of the air compressor, and can greatly prolong the service life of the air compressor. Such piston type air compressor may have a wide application in the field of automobiles. For example, it may be used in the automobile for driving the automobile seat move forward and backward, adjusting lumbar support or the support of body by the seat, and the like. The air compressor may also be used for different occasions such as coffee machines, massage chairs and the like.

[0036] Yet another aspect of the present invention provides an automobile seat having a piston type air compressor in accordance with the foregoing aspects of the present invention. As previously described, the piston type air compressor may be used in the automobile seat for driving the automobile seat move forward and backward, adjusting the lumbar support, the wrap of body by

the seat or to provide the function of massage chairs and the like. Still another aspect of the present invention further provides an automobile that may have a piston type air compressor of the foregoing aspects, and/or that may have the automobile seat of the foregoing aspect. It can be seen that the arrangement of the air compressor in the automobile thus provided is not limited to being in the automobile seat. It will be appreciated that the automobile seats and automobiles in these aspects of the present invention will have the advantages respective to the foregoing air compressors.

[0037] The technical scope of the present invention is not limited to the content in the above description, those skilled in the art may make a variety of alterations and modifications to the above-described embodiments without departing from the technological thoughts of the invention, and all these alternations and modifications are intended to be within the scope of the invention.

Claims

1. A cylinder for a piston type air compressor, wherein a cavity is defined in a cylinder block of the cylinder, a liner is attached to an inner sidewall of the cavity, the liner is securely bonded to the inner sidewall, and the liner defines a compression cavity of the air compressor.
2. The cylinder of claim 1, wherein a smoothness of an inner surface of the liner is greater than the smoothness of a surface of the cylinder block itself.
3. The cylinder of claim 1 or 2, wherein the liner is die cast together with the cylinder block.
4. The cylinder of claim 1 or 2, wherein securing between the liner and the cylinder block is achieved by a threaded connection.
5. The cylinder of claim 1 or 2, wherein the inner sidewall of the liner is in a straight cylindrical shape and shape and size of a cross-section of the liner at both ends are the same.
6. The cylinder of claim 1 or 2, wherein the liner is a deep drawn tube made of aluminum or aluminum alloy.
7. The cylinder of claim 6, wherein the cylinder is die cast by zinc or zinc alloy with the liner.
8. A piston type air compressor, wherein a cylinder of the air compressor is the cylinder of any of the foregoing claims 1 to 7.
9. An automobile seat, wherein the piston type air compressor of claim 8 is provided in the automobile seat.

10. An automobile, wherein the automobile is provided with the piston type air compressor of claim 8, and/or the automobile is provided with the automobile seat of claim 9.

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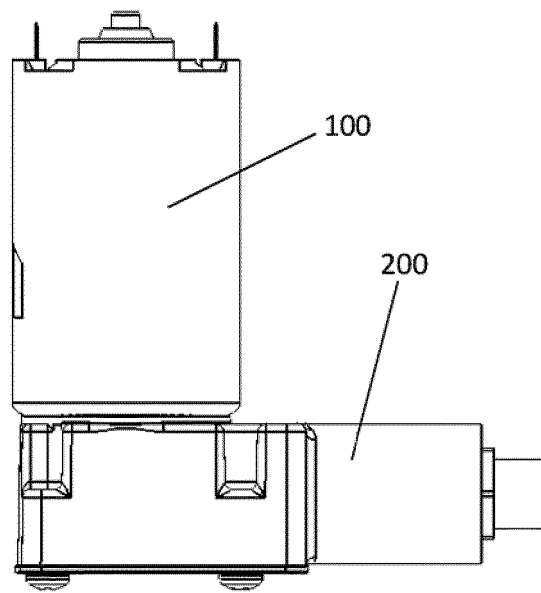


Fig. 1

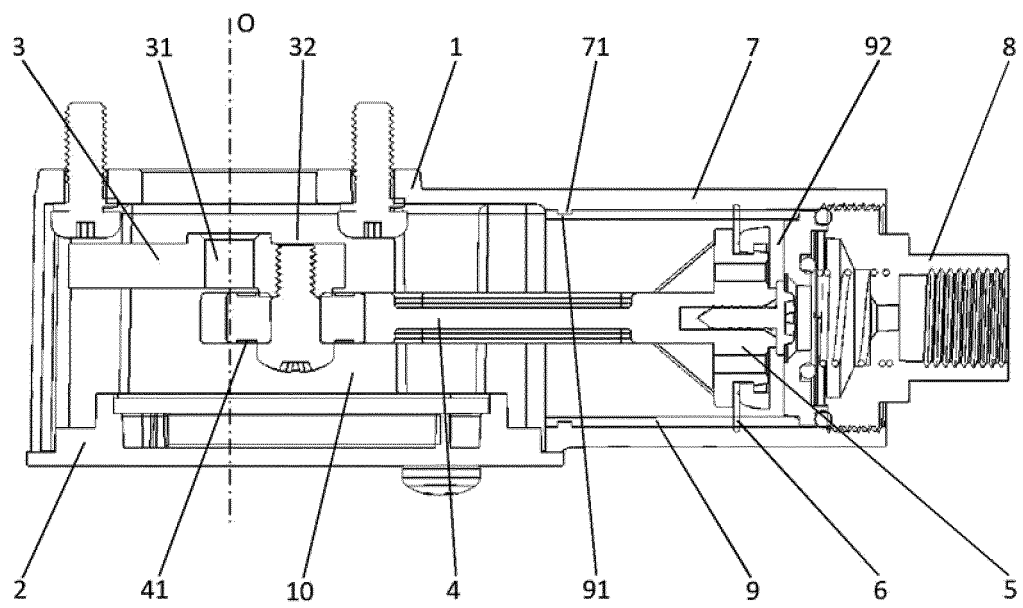


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/106823

A. CLASSIFICATION OF SUBJECT MATTER F04B 39/12(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) F04B																		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPI; EPODOC; CNPAT; CNKI: 空压机, 空气压缩机, 活塞, 气缸, 汽缸, 缸套, 衬, compressor, air, cylinder, piston, sleeve, bush																		
C. DOCUMENTS CONSIDERED TO BE RELEVANT																		
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>E</td> <td>CN 207363851 U (DONGGUAN ACTIVE TOOLS CO., LTD. ET AL.) 15 May 2018 (2018-05-15) claims 1-10</td> <td>1-10</td> </tr> <tr> <td>X</td> <td>CN 206513530 U (XIAMEN WONDERROAD TECHNOLOGY CO., LTD.) 22 September 2017 (2017-09-22) description, paragraphs 16-22, and figure 1</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 203146271 U (LONGKOU DACHUAN PISTON CO., LTD.) 21 August 2013 (2013-08-21) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 202370786 U (ANQING BAILIAN OIL FREE COMPRESSOR CO., LTD.) 08 August 2012 (2012-08-08) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 2305496 Y (LONGKOU CITY AIR PUMP GROUP CO., LTD.) 27 January 1999 (1999-01-27) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	E	CN 207363851 U (DONGGUAN ACTIVE TOOLS CO., LTD. ET AL.) 15 May 2018 (2018-05-15) claims 1-10	1-10	X	CN 206513530 U (XIAMEN WONDERROAD TECHNOLOGY CO., LTD.) 22 September 2017 (2017-09-22) description, paragraphs 16-22, and figure 1	1-10	A	CN 203146271 U (LONGKOU DACHUAN PISTON CO., LTD.) 21 August 2013 (2013-08-21) entire document	1-10	A	CN 202370786 U (ANQING BAILIAN OIL FREE COMPRESSOR CO., LTD.) 08 August 2012 (2012-08-08) entire document	1-10	A	CN 2305496 Y (LONGKOU CITY AIR PUMP GROUP CO., LTD.) 27 January 1999 (1999-01-27) entire document	1-10
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Date of the actual completion of the international search 22 June 2018	Date of mailing of the international search report 13 July 2018																	
Name and mailing address of the ISA/CN State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																	

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/106823**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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CN 207363851 U	15 May 2018	None	
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