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(54) **SCREW COMPRESSOR, AIR CONDITIONING DEVICE AND REFRIGERATING DEVICE**

(57) Disclosed are a screw compressor, and a gas conditioning apparatus and a refrigeration apparatus including the screw compressor. The screw compressor includes a body (10), in which a gas-supplement channel is provided, and the gas-supplement channel has at least two gas-supplement holes (201) communicated with a compression chamber. A number of the gas-supplement holes in the screw compressor is at least two. In a case that space available in the body (10) for disposing the gas-supplement holes (201) is limited, a hole diameter of each of the gas-supplement holes (201) is smaller. A larger number of gas-supplement holes (201) with smaller hole diameter are beneficial for reducing gas flow pulsation, thereby reducing noise in a gas-supplement process.

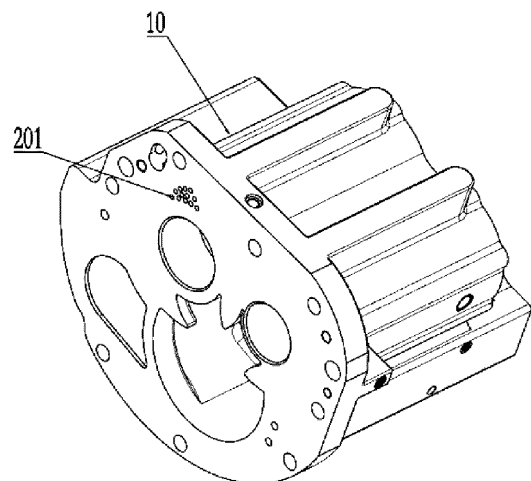


FIG.2

Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority of Chinese Patent Application No. 201710283983.8, filed on April 26, 2017, entitled "Screw Compressor, Air Conditioning Apparatus and Refrigeration Apparatus", the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to the field of compressor technology, and particularly to a screw compressor, an air conditioning apparatus and a refrigeration apparatus including the screw compressor.

BACKGROUND

[0003] The screw compressor generally includes a body and a couple of parallel and mutual engaged female and male screws provided in the body. A gas intake is provided in the body corresponding to one end of the female screw and one end of the male screw, and an exhaust port is provided in the body corresponding to the other end of the female screw and the other end of the male screw. The screw compressor compresses the low-temperature and low-pressure gas entering from the gas intake of the body into high-temperature and high-pressure gas, and discharges the high-temperature and high-pressure gas from the exhaust port of the body through the rotation of the female and male screws in opposite directions to each other.

[0004] The body of the existing screw compressor is usually further provided with a gas-supplement channel for supplementing the gas into a compression chamber between the female and male screws in order to improve the compression efficiency of the screw compressor.

[0005] The existing gas-supplement channel can be divided into axial gas-supplement and radial gas-supplement channels according to the disposing mode. In the case of axial gas-supplement channel in the existing screw compressor, as shown in FIG. 1, the body 10' is provided with a gas-supplement channel, and the inner end of the gas-supplement channel is provided with an axial gas-supplement hole 201' configured to make the gas-supplement channel be communicated with the compression chamber between the female and male screws. The number of the axial gas-supplement holes 201' is one, and meanwhile the hole diameter is relatively larger. The screw compressor having the above-mentioned gas-supplement channel structure may cause a larger gas flow pulsation when the gas in the air-supplement channel enters the compression chamber between the female and male screws through the axial gas-supplement hole 201', resulting in a larger noise.

SUMMARY

[0006] The present disclosure provides a screw compressor, an air conditioning apparatus and a refrigeration apparatus, to reduce the gas flow pulsation in the gas-supplement process.

[0007] According to one aspect of the present disclosure, the present disclosure provides a screw compressor including:

a body, comprising a housing, in which a compression chamber is provided, and
a gas-supplement channel, disposed in the body, the gas-supplement channel having at least two gas-supplement holes communicated with the compression chamber.

[0008] Further, the gas-supplement holes are disposed along an axial direction of the body.

[0009] Further, a shape of cross section of each gas-supplement hole is any one of a circle, an ellipse, a round rectangle and a polygon.

[0010] Further, a radial dimension of each of the gas-supplement holes is not greater than 6 mm, or the radial dimension of each of the gas-supplement holes is not less than 2 mm.

[0011] Further, a shape of cross section of each gas-supplement hole is a circle, and each of the gas-supplement holes has a diameter of 5 mm.

[0012] Further, the screw compressor further includes a male screw and a female screw disposed in the compression chamber; wherein at least a portion of the gas-supplement holes are arranged in a shape corresponding to a partial outer contour of the male screw.

[0013] Further, at least three gas-supplement holes are arranged to form a first group; centers of the gas-supplement holes in the first group are arranged to form an arc which is concentric with the male screw.

[0014] Further, a contour of the gas-supplement channel is determined by a position of the male screw and an exhaust channel of the screw compressor; and a distance from a center of each gas-supplement hole disposed in an outer layer to a contour of the gas-supplement channel is a fixed value.

[0015] Further, the body further includes: end bearing seat, provided at an end of the housing; wherein at least a first part of a length section of the gas-supplement channel is disposed in the exhaust end bearing seat, and the gas-supplement holes are provided in the exhaust end bearing seat.

[0016] According to another aspect of the present disclosure, the present disclosure provides an air conditioning apparatus including the screw compressor above.

[0017] According to yet another aspect of the present disclosure, the present disclosure provides a refrigeration apparatus including the screw compressor above.

[0018] In the screw compressor provided by the present disclosure, the gas-supplement channel thereof

has a plurality of gas-supplement holes for communicating with the compression chamber, so that in the case that the space available on the body for disposing the gas-supplement holes is limited, each of the gas-supplement holes has a smaller hole diameter. In the gas-supplement process, compared with the gas-supplement hole with a larger hole diameter in the prior art, in the screw compressor provided by the present disclosure, a larger number of gas-supplement holes with smaller hole diameters are more beneficial for reducing gas flow pulsation, thereby helping to reduce noise in the gas-supplement process.

[0019] The gas conditioning apparatus and the refrigeration apparatus provided by the present disclosure adopt the above-described screw compressor provided by the present disclosure, and can reduce the gas flow pulsation in the gas-supplement process, thereby helping to reduce the noise in the gas-supplement process.

BRIEF DESCRIPTION OF DRAWINGS

[0020] The accompanying drawings described herein are provided to further understand the present disclosure and are a part of the present disclosure. The schematic embodiments of the disclosure and the illustration thereof are used to interpret the disclosure but not intended to limit the disclosure. In the drawings:

FIG. 1 is a schematic view illustrating an axial gas-supplement hole in an existing screw compressor;
 FIG. 2 is a schematic stereogram illustrating a gas-supplement hole in a screw compressor according to an embodiment of the present disclosure;
 FIG. 3 is a schematic front view illustrating a gas-supplement hole in a screw compressor according to an embodiment of the present disclosure.
 FIG. 4 is a schematic view illustrating an arrangement of gas-supplement holes in a screw compressor according to an embodiment of the present disclosure.

Description of the reference signs:

[0021] 10'. body; 201'. axial gas-supplement hole; 10. body; 201. gas-supplement hole; 31. first group; 40. male screw.

DETAILED DESCRIPTION OF DISCLOSED EMBODIMENTS

[0022] The embodiments of the present disclosure are described in detail below, and the examples of the embodiments are illustrated in the accompanying drawings. The same or similar reference signs mean the same or similar elements, or elements having the same or similar functions. The embodiments described below with reference to the accompanying drawings are illustrative and used to interpret the disclosure, but not intended to limit

the present disclosure.

[0023] The present disclosure provides a screw compressor. In an embodiment, as shown in FIG. 2 and FIG. 3, the screw compressor includes a body 10. The body 10 includes a housing, in which a compression chamber is provided, and a gas-supplement channel is provided in the body 10. The gas-supplement channel has a plurality of gas-supplement holes 201 communicating with the compression chamber.

[0024] For example, the gas-supplement hole 201 is an axial gas-supplement hole, that is, the gas-supplement hole 201 is parallel with the axis of the body 10, which is beneficial for processing. In addition, the gas-supplement hole 201 may be arranged to be inclined relative to the axis of the body 10.

[0025] In the present embodiment, the number of the gas-supplement holes 201 of the gas-supplement channel for communicating with the compression chamber is multiple, so that in the case that the space available in the body 10 for disposing the gas-supplement holes 201 is limited, the hole diameter of each of the gas-supplement holes 201 is smaller.

[0026] The principle and working process of the screw compressor provided by the present disclosure will be described in detail below with reference to the accompanying drawings.

[0027] Taking a screw compressor being a twin-screw compressor as an example, specifically, the screw compressor further includes a couple of parallel and mutual engaged male and female screws, and a driving mechanism. The driving mechanism is connected to the male screw and configured to drive the male screw to rotate, thereby driving the female screw engaged with the male screw to rotate. One end of the body 10 is provided with a gas intake, and the other end of the body 10 is provided with an exhaust port. The gas intake and the exhaust port are respectively located at two sides of the female and male screws.

[0028] When the screw compressor is working, driven by the driving mechanism, the male screw and the female screw rotate in opposite directions with each other. When the compression chamber between the female and male screws is communicated with the gas intake, the gas enters the compression chamber between the female and male screws through the gas intake; and after being compressed, the gas is discharged from the exhaust port when the compression chamber is communicated with the exhaust port.

[0029] In the above process, when the compression chamber is communicated with the gas-supplement hole 201, the gas is supplemented into the compression chamber through the gas-supplement channel, to improve the compression efficiency of the screw compressor. When the gas in the gas-supplement channel passes through the gas-supplement channel, the gas volume passing through the gas-supplement channel is a fixed value, therefore a total gas volume passing through the plurality of gas-supplement holes 201 is a fixed value.

Since the number of the gas-supplement holes 201 is multiple, in the case that the total gas volume is constant, the hole diameter of each of the gas-supplement holes 201 is relatively smaller, and the gas flow pulsation generated by the gas passing through the gas-supplement holes 201 is smaller, thereby reducing the noise formed when the gas is supplemented into the compression chamber.

[0030] In the above, the principle and process of the present disclosure are described in detail by taking the screw compressor being a twin-screw compressor as an example. However, it should be noted that the screw compressor provided by the present disclosure may also be other possible structures, and is not limited to the above-mentioned twin-screw compressor.

[0031] In the present embodiment, the shape of each of the gas-supplement holes 201 can be various regular shapes such as a circle, an ellipse, a round rectangle, a polygon and so on, and can also be other irregular shapes. In practical applications, the shape of the gas-supplement hole 201 can be configured to be any shape desired or capable of achieving the corresponding purpose according to requirements.

[0032] Preferably, a radial dimension of each of the gas-supplement holes 201 is not greater than 6 mm. When the gas-supplement hole is circular, the radial dimension is the diameter of the hole. Such setting defines the maximum dimension of the hole diameter of the gas-supplement hole 201, i.e., the hole diameter is limited within a range of not greater than 6 mm, which can better reduce the gas flow pulsation in the gas-supplement process, thereby enabling the noise to be lower.

[0033] Furthermore, the radial dimension of each of the gas-supplement holes 201 is not less than 2 mm. When the gas-supplement hole 201 is circular, the radial dimension is the diameter of the hole. The shape of the axial gas-supplement hole 201 is configured to be circular for easy processing, thereby reducing the processing cost. As shown in FIG. 3, each of the gas-supplement holes 201 has a diameter of 5 mm.

[0034] Preferably, referring to FIG. 4, a male screw 40 and a female screw are provided in the body 10, and a plurality of gas-supplement holes 201 are arranged in a shape corresponding to the tooth root of the male screw 40. Such an arrangement can reduce the gas flow pulsation in the gas-supplement process, which helps to reduce the noise in the gas-supplement process.

[0035] In the present embodiment, as shown in FIG. 2, the body 10 further includes an exhaust end bearing seat. The exhaust end bearing seat is disposed at an end of the housing, and at least a portion of the length of the gas-supplement channel can be disposed in the exhaust end bearing seat of the body 10. The body structure shown in FIGS. 2 and 3 is the exhaust end bearing seat.

[0036] In an embodiment, a first part of the length section of the gas-supplement channel is disposed in the exhaust end bearing seat; a second part of the length section of the gas-supplement channel is disposed in the

housing, and the gas-supplement holes 201 are disposed in the exhaust end bearing seat. The gas supplemented into the compressor first enters into the second part of the length section the gas-supplement channel, which is located in the housing, then enters the first part of the length section of the gas-supplement channel, which is located in the exhaust end bearing seat, and then enters the compression chamber of the body through the gas-supplement hole 201.

[0037] In the screw compressor provided by the present embodiment, the number of the gas-supplement holes 201 in the gas-supplement channel for communicating with the compression chamber is multiple, so that in the case that the space available in the body 10 for disposing the gas-supplement holes 201 is limited, each of the gas-supplement holes 201 has a smaller hole diameter. In the gas-supplement process, compared with the gas-supplement hole with a larger hole diameter in the prior art, the screw compressor provided by the present disclosure has a larger number of gas-supplement holes 201 with smaller hole diameter, which is more beneficial for reducing the gas flow pulsation, and helps to reduce the noise in the gas-supplement process.

[0038] As shown in FIG. 4, at least two gas-supplement holes 201 are arranged to form a first group 31, and at least three gas-supplement holes 201 are arranged in the first group 31. Centers of all gas-supplement holes 201 in the first group 31 form an arc. The arc and the male screw 40 are concentric. An arc at the position indicated by 31 in FIG. 4, is the arc formed by the centers of a plurality of gas-supplement holes 201 in the first group 31.

[0039] The contour B of the gas-supplement channel is determined by the position of the male screw 40 and the exhaust channel of the screw compressor, and a distance from the center of the gas-supplement hole 201 in the outer layer to the contour B of the gas-supplement channel is a fixed value. Under the premise that the exhaust channel of the screw compressor and the male screw 40 are fixed, the shape of the contour B is also fixed, that is, the shape of the contour B is also the cross-sectional shape of the original gas-supplement channel. The present disclosure also provides an air conditioning apparatus including, in this embodiment, the screw compressor in the above-described embodiments of the present disclosure.

Claims

1. A screw compressor, **characterized by** comprising:

a body (10), comprising a housing, in which a compression chamber is provided, and
a gas-supplement channel, disposed in the body (10), the gas-supplement channel having at least two gas-supplement holes (201) communicated with the compression chamber.

2. The screw compressor according to claim 1, **characterized in that** the gas-supplement holes (201) are disposed along an axial direction of the body (10).
3. The screw compressor according to claim 1, **characterized in that** a shape of cross section of each gas-supplement hole (201) is any one of a circle, an ellipse, a round rectangle and a polygon. 5
4. The screw compressor according to claim 1, **characterized in that** a radial dimension of each of the gas-supplement holes (201) is not greater than 6 mm, or the radial dimension of each of the gas-supplement holes (201) is not less than 2 mm. 10
5. The screw compressor according to claim 4, **characterized in that** a shape of cross section of each gas-supplement hole (201) is a circle, and each of the gas-supplement holes (201) has a diameter of 5 mm. 15 20
6. The screw compressor according to claim 1, **characterized by** further comprising a male screw (40) and a female screw disposed in the compression chamber; wherein at least a portion of the gas-supplement holes (201) are arranged in a shape corresponding to a partial outer contour of the male screw (40). 25
7. The screw compressor according to claim 6, **characterized in that** at least three gas-supplement holes (201) are arranged to form a first group (31); and centers of the gas-supplement holes (201) in the first group (31) are arranged to form an arc which is concentric with the male screw (40). 30 35
8. The screw compressor according to claim 6, **characterized in that** a contour of the gas-supplement channel is determined by a position of the male screw and an exhaust channel of the screw compressor; and a distance from a center of each gas-supplement hole (201) disposed in an outer layer to a contour of the gas-supplement channel is a fixed value. 40
9. The screw compressor according to claim 1, **characterized in that** the body (10) further comprises: an exhaust end bearing seat, provided at an end of the housing; wherein at least a first part of a length section of the gas-supplement channel is disposed in the exhaust end bearing seat, and the gas-supplement holes (201) are provided in the exhaust end bearing seat. 45 50
10. An air conditioning apparatus comprising the screw compressor of claim 1. 55
11. A refrigeration apparatus comprising the screw compressor of claim 1.

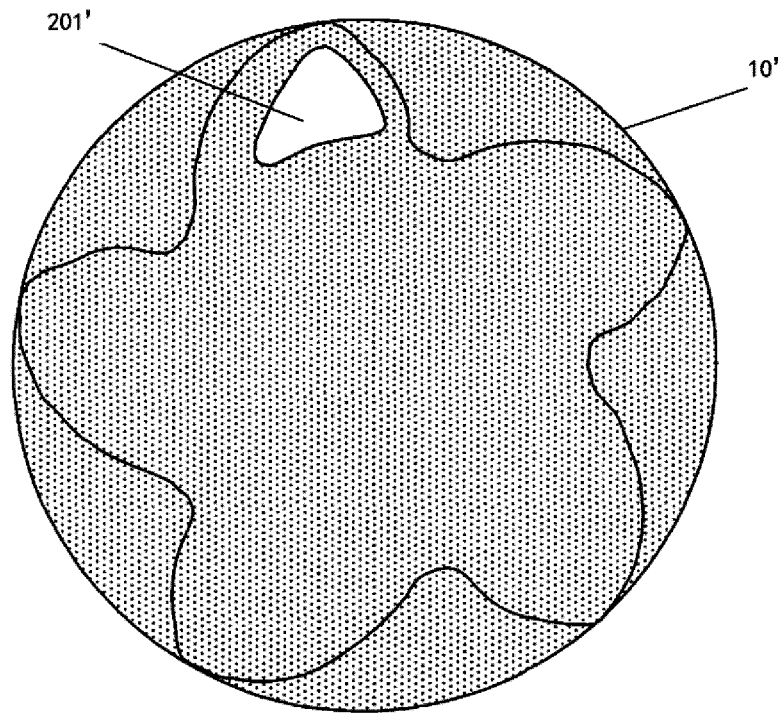


FIG.1

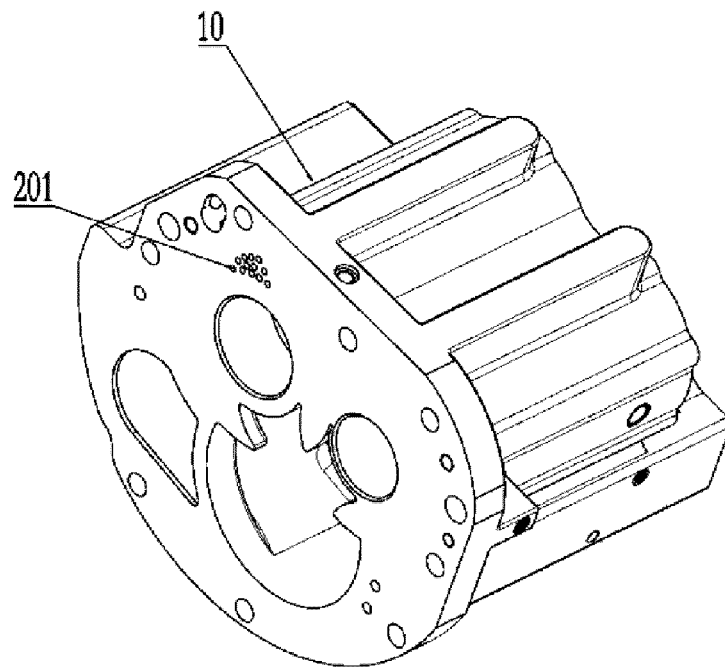


FIG.2

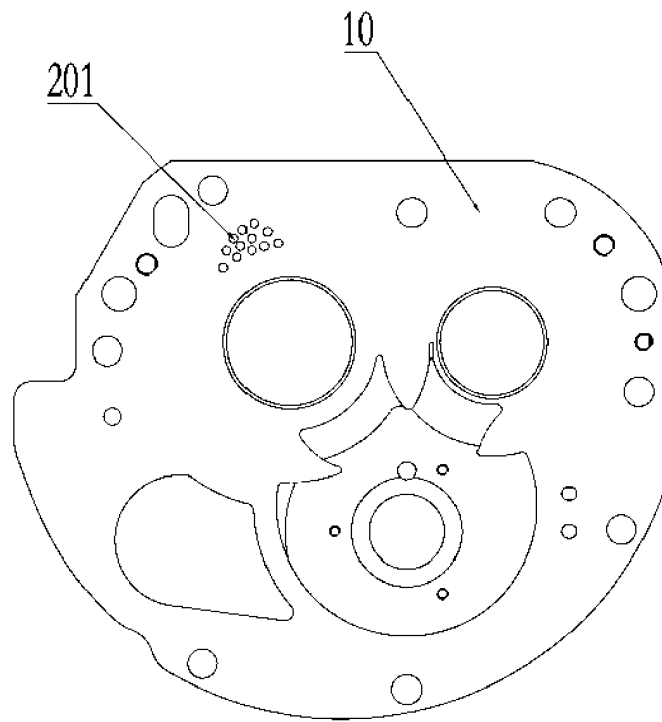


FIG. 3

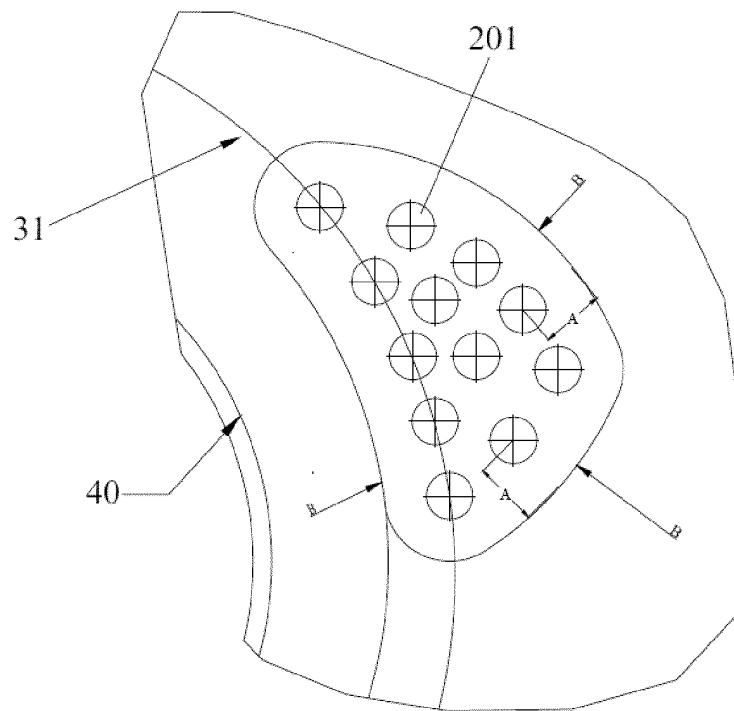


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/119427

A. CLASSIFICATION OF SUBJECT MATTER

F04C 29/12 (2006.01) i; F04C 29/06 (2006.01) i; F04C 18/16 (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)

F04C 29, F04C 18

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)

CNABS; CNTXT; CNKI; VEN; USTXT; EPTXT: 螺杆, 螺旋, 补气, 增焓, 喷射, 孔, screw, compressor, blowdown, eject+, jet+, inject+, spout+, squirt+, hole, pore, vent, orifice, aperture, finestra, gas, air, two, twin, double, multi+

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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☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search 26 January 2018	Date of mailing of the international search report 16 March 2018
Name and mailing address of the ISA 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 ZHAI, Li'na Telephone No. (86-512) 88995277

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/119427

C (Continuation). 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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Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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