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(54) **VOLUTE STRUCTURE, CENTRIFUGAL COMPRESSOR AND REFRIGERATION DEVICE**

(57) The present application discloses a volute structure, a centrifugal compressor and a refrigeration device. The volute structure comprises: a cabinet (8), a volute casing (1) and a backflow device (5); the volute casing (1) comprises an inner volute and an outer volute separately provided, a fluid flow passage being formed between the inner volute and outer volute, and the inner volute and backflow device (5) being disposed together. The present application increases the length of the first-stage diffuser, improving the diffusion effect of air entering the first-stage diffuser and thus enhancing the unit performance of the centrifugal compressor.

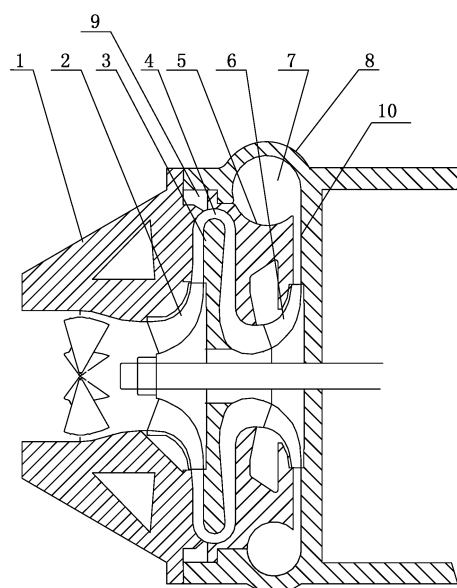


Fig. 2

Description

[0001] The present application claims the priority of a Chinese patent application No. 201410549697.8 entitled "Volute Structure, Centrifugal Compressor, and Refrigeration Equipment" filed on October 16, 2014, all contents of which are incorporated in the present application by reference.

FIELD OF THE INVENTION

[0002] The present application relates to refrigerant equipment, and more specifically relates to a volute structure, a centrifugal compressor and a refrigerant equipment.

BACKGROUND OF THE INVENTION

[0003] In double-stage and multi-stage centrifugal compressor structures, in order to reduce the length of a cantilever end of a main shaft, enhance a threshold rotating speed, and enhance stability, a pneumatic part of multi-stage compression is always made very compact. However, the pneumatic part of a centrifugal compressor includes many components, such that it is very difficult to arrange the components of the pneumatic part of the centrifugal compressor. Particularly in a volute front tilting-type multi-stage compression, the volute is very close to a curve passage behind a first-stage diffuser outlet, such that the structure is not satisfied.

[0004] Fig. 1 is a schematic diagram of a layout of a pneumatic part of a volute front tilting-type double-stage centrifugal compressor, in which an internal arc cavity of the volute faces downstream of air flow. The centrifugal type compressor pneumatic part mainly comprises a deflector, a first-stage impeller, a first-stage diffuser, a curve passage, a backflow device, a second-stage impeller, a second-stage diffuser, and a volute 21. The centrifugal compressor comprises a main shaft 20 and the volute 21. In the prior art, in order to improve the structure, the curve passage is arranged as far as possible from the volute 21 by narrowing the length of the first-stage diffuser, while increasing the cantilever end length of the main shaft 20.

[0005] The inventors find that the prior art at least has the following drawbacks: narrowing the length of the first-stage diffuser section will result in that the gas entering the centrifugal compressor cannot be sufficiently diffused, which will deteriorate the performance of the centrifugal compressor. Further, increasing the length of the main shaft 20 results in reduction of the threshold rotating speed, deterioration of the operation stability, and degradation of performance of the compressor.

SUMMARY OF THE INVENTION

[0006] One of objectives of the present application is to provide a volute structure, a centrifugal compressor,

and a refrigerant device, for optimizing a pneumatic structure of the existing centrifugal compressor, and enhancing unit performance and stability of the compressor.

[0007] In order to achieve the objective above, the present application provides the following technical solutions:

[0008] The present application provides a volute structure, comprising: a cabinet, a volute housing, and a backflow device; the volute housing comprising an inner volute and an outer volute which are separately provided, a fluid passage being formed between the inner volute and the outer volute; and the inner volute being arranged with the backflow device.

[0009] In the above volute structure, optionally, the inner volute and the backflow device are casted integrally.

[0010] In the above volute structure, optionally, outer volute and the cabinet are casted integrally.

[0011] In the above volute structure, optionally, a connection portion between the inner volute and the outer volute is rounded.

[0012] In the above volute structure, optionally, the volute structure further comprises a curve passage that is fixed on backflow device.

[0013] In the above volute structure, optionally, the curve passage and the backflow device are casted integrally.

[0014] The present application further provides a centrifugal compressor, comprising a volute structure according to the present application

[0015] In the above centrifugal compressor, optionally, the centrifugal compressor also comprises a housing, and the volute structure further comprises a one-stage diffuser; and the housing, the cabinet, the one-stage diffuser, and the backflow device enclose a one-stage gas supply cavity.

[0016] In the above centrifugal compressor, optionally, the centrifugal compressor is a double-stage or multi-stage centrifugal compressor.

[0017] The present application further provides a refrigerant device, comprising a centrifugal compressor according to the present application.

[0018] Based on the technical solution above, embodiments of the present application could at least achieve the following technical effect:

[0019] In the technical solutions above, the volute housing is divided into two separate parts: an inner volute and an outer volute. Moreover, the inner volute and the backflow device are arranged together, which saves the space occupied by the inner volute and the backflow device, downsizes the structure of connecting the volute, backflow device, and curve linkage, such that the volute housing and the curve are arranged close enough in the structure. Meanwhile, it guarantees enough length of the first-stage diffuser and improves the diffusion effect of the gas entering into the first-stage diffuser, thereby enhancing unit performance and the operation stability of the centrifugal compressor. In addition, the technical solution also shortens the length of a main shaft, thereby

raising the threshold rotating speed of the rotary part of the compressor, enhancing the operation stability and compressor performance of the centrifugal compressor.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0020] The drawings illustrated here are for providing further understanding of the present application and thus constitute part of the present application. The exemplary embodiments of the present application and depictions thereof are for interpreting the present application, not constituting improper limitations of the present application. In the drawings:

Fig. 1 is a layout diagram of a pneumatic part of a volute front tilting type double-stage centrifugal compressor in the prior art;

Fig. 2 is a partial section view of a volute structure applied to a centrifugal compressor according to embodiments of the present application;

Reference Numerals:

[0021] 1. Casing; 2. First-stage impeller; 3. First-stage diffuser; 4. Curve Passage; 5. Backflow device; 6. Second-stage impeller; 7. Volute housing; 8. Cabinet; 9. First-stage air supply cavity; 10. Second-stage diffuser; 20. Main shaft; 21. Volute.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Hereinafter, the technical solution of the present application will be described in more detail with reference to Fig. 2. Any technical solution resulting from replacement of any technical means of the present application or combination of any two or more technical means or technical features provided by the present application should be included in the protection scope of the present application.

[0023] Front and rear in the present disclosure reference the air flow direction of the volute structure, i.e., upstream of the air flow is front, namely the left side of Fig. 2; while downstream of the air flow is rear, i.e., right side of Fig. 2.

[0024] The embodiment of the present application provides a volute structure, which is preferably applied to a centrifugal compressor and the like. The volute structure is configured to be a front tilting type volute structural (as shown in fig.2, internal curve cavity of the volute housing 7 faces the upstream of the air flow, i.e. left side of fig.2), or a rear tilting type volute structural. The volute structural is preferably applied to double-stage centrifugal compressor or a last stage of the multi-stage centrifugal compressor in which the volute housing is located, such that the centrifugal compressor structure is more compact,

and the stability and unit performance of the centrifugal compressor are enhanced.

[0025] The volute structure comprises a cabinet 8, a volute housing 7, and a backflow device 5. The volute housing 7 includes an inner volute and an outer volute, which are separately provided. A fluid passage is formed between the inner volute and the outer volute, for fluids to pass through. The inner volute and the backflow device 5 are arranged together.

[0026] Besides, the volute housing 7 is circumferentially split into two parts: inner volute and outer volute. The inner volute and the backflow device 5 are arranged together in at least the following manners: the inner volute and the backflow device 5 are fixedly connected, or the two are of an integral structure.

[0027] In the technical solution above, the volute housing is divided into two separate parts: an inner volute and an outer volute. Moreover, the inner volute and the backflow device are arranged together, which saves the space occupied by the inner volute and the backflow device, downsizes the structure of fixing the volute, backflow device, and curve linkage, such that the volute housing and the curve may arranged close enough in the structure. Meanwhile, it guarantees enough length of the first-stage diffuse and improves the diffusion effect of the gas entering into the first-stage diffuser, thereby enhancing unit performance of the centrifugal compressor and the operation stability of the centrifugal compressor. In addition, the technical solution above also shortens the length of main shaft, thereby raising the threshold rotating speed of the rotary part of the compressor, enhancing the operation stability and compressor performance of the centrifugal compressor.

[0028] In addition, the inner volute and the backflow device are arranged together, which reduces the number of components, such that while the pneumatic part of the centrifugal compressor maintains a compact structure, parameters of the components of the pneumatic part will be coordinated more reasonably with a better pneumatic performance. With an example of applying the volute structure to a centrifugal compressor, the threshold rotating speed of the centrifugal compressor is related to the main shaft length of the centrifugal compressor. By dividing the volute housing into an outer volute and an inner volute, positions of the outer volute and the inner volute may be arranged more reasonably without changing the main shaft length of the centrifugal compressor, i.e., arrangement of the volute housing may be made without affecting the threshold rotating speed and the unit performance of the centrifugal compressor. In addition, by dividing the volute housing into an outer volute and an inner volute, the main shaft length may be shortened based on the existing mechanism, with an enhanced compressor threshold rotating speed. Enhance of the threshold rotating speed results in enhancement of the compressor stability, meanwhile the length of the main shaft is shortened, the bearing length or diameter is be shortened, the power consumption is reduced and

the compressor performance is enhanced.

[0029] Furthermore, the shape of the volute will not change by dividing the volute housing into separate inner volute and outer volute, thereby not affecting the pneumatic performance of the volute. In addition, by dividing the volute housing into an outer volute and an inner volute, the volute casting process would be simplified. Meanwhile, an existing digital control processing center may be employed for secondary processing of the inner volute based on casting, which enhances unit performance and cabinet universality, thereby facilitating universality between different machine models, further reducing the molding times and expenses of new boxes.

[0030] Further, the volute structure further comprises a curve passage 4 provided on the backflow device 5.

[0031] In the present embodiment, the inner volute and the curve 4 are simultaneously fixed to the backflow device 5, which saves an air supply pipeline disposed between the curve passage and the backflow device in the existing centrifugal compressor, such that the curve passage and the inner volute would be arranged more compact in structure, thereby further compacting the structure of a double-stage or multi-stage centrifugal compressor. However, a integral type volute structure is usually employed in the prior art, such that in order to mount a backflow device and avoid too small distance between the curve passage and the volute (i.e., the distance of the apex of the curve passage from the nearest point of volute housing along a main shaft direction), the axial length of the main shaft has to be lengthened, which would reduce the threshold rotary speed of the compressor, thereby reducing stability of the compressor.

[0032] Here, the inner volute and the backflow device 5 are formed into an integral structure through casting, i.e., the arc shape of the inner volute is formed at an external side of the backflow device 5. The inner volute is arranged on the backflow device 5. By casting, a profile of the inner volute would be processed by a current processing center, which expands the structure of the volute, such that the volute would be better matched with other pneumatic elements (impeller, diffuser) with a better performance, without changing the volute structure at the ease of arranging the structure, which might affect the pneumatic performance.

[0033] In order to enhance the strength of the overall structure and reduce the mounting difficulty, the curve 4 and the backflow device 5 could also be casted into an integral structure.

[0034] Furthermore, the outer volute and the cabinet 8 are casted into an integral structure, i.e., the arc shape of the outer volute is formed at an inner side of the box 8. With this structure, a improved volute profile may be adopted in the overall arrange, without changing the volute structure at the ease of arranging the structure, which might affect the pneumatic performance.

[0035] Besides, the inner volute and the backflow device 5 are of an integral structure, and the inner volute and the cabinet 8 are of an integral structure, which may

also be understood as such that the backflow device 5 and the cabinet 8 together form a volute housing 7. In the embodiment, the outer volute is disposed on the cabinet 8, and the inner volute is disposed on the backflow device 5. By means of precise casting and high-precision processing of the processing center, good connection between the inner and outer volutes is guaranteed.

[0036] In the present embodiment, further, a connection part between the inner volute and the outer volute is rounded so as to avoid connection displacement therebetween.

[0037] Embodiments of the present application further provide a centrifugal compressor, comprising a volute structure according to any technical solution of the present application.

[0038] With reference to Fig. 2, the entire centrifugal compressor mainly comprises a casing 1, a first-stage impeller 2, a first-stage diffuser 3, a curve passage 4, a backflow device 5, a second-stage impeller 6, a second-stage diffuser 10, a volute housing 7, and a cabinet 8. Particularly, volute front tilting means that volute tilts to the air inlet side (left side of Fig. 2). The air flow sequentially enters into the first-stage impeller 2, the first-stage diffuser 3, curve passage 4, second-stage impeller 6, second-stage diffuser 10, and volute housing 7, finally implementing air pressure boost.

[0039] The volute structure is one of important components of pneumatic parts of the centrifugal compressor. Besides the volute structure, the centrifugal compressor pneumatic parts further comprises an impeller and a pneumatic motor.

[0040] Further, the centrifugal compressor further comprises a casing 1. The volute structure further comprises a first-stage diffuser 3. The casing 1, the cabinet 8, the first-stage diffuser 3 and the backflow device 5 enclose a first-stage air supply cavity 9. Namely, the cabinet 8 not only forms the volute housing 7 but also forms a first-stage air supply cavity 9.

[0041] The centrifugal compressor changes a position of setting the first-stage air supply cavity 9. The casing 1, the cabinet 8, the first-stage diffuser 3 and the backflow device 5 enclose the first-stage air supply cavity 9, such that an air supply function may be implemented without adding an air supply part.

[0042] As mentioned above, the centrifugal compressor is a double-stage or multi-stage centrifugal compressor.

[0043] Embodiments of the present application further provide a refrigerant equipment, comprising a centrifugal compressor provided according to any technical solution of the present application. A refrigerant equipment having the centrifugal compressor has a more compact centrifugal compressor pneumatic structure with a better operation stability of the compressor and a better pneumatic performance. The refrigerant equipment comprises air condition units.

[0044] In depictions of the present application, it should be understood that orientations or positional relation-

ships indicated by terms like "center", "longitudinal", "transversal", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer" and others are based on the orientations or positional relationships illustrated in the accompanying drawings, which are only for facilitating depiction of the present application and simplifying the depiction, rather than indicating or suggesting that the specified means or elements must have specific orientations or have to be constructed and operated with the specific orientations; Therefore, they should not be understood as limitation to the protection scope of the present application.

[0045] If words like "first" and "second" used here are for limiting components, those skilled in the art should know that use of "first" and "second" is only for at the ease of distinguishing the spare parts; unless otherwise indicated, the words have no special meanings.

[0046] Finally, it should be stated that the embodiments above are only for illustrating the technical solution of the present application, not for limiting it; although the present application have been described in detail with reference to the preferred embodiments, those skilled in the art should understand that the preferred embodiments of the present application may be modified or part of technical features may be replaced in equivalence; without departing from the spirit of the technical solution of the present application, such modifications and equivalent replacements should be covered within the scope of the technical solution as recited in the present application.

Claims

1. A volute structure, comprising: a cabinet, a volute housing, and a backflow device;
the volute housing comprising an inner volute and an outer volute which are separately provided, a fluid passage being formed between the inner volute and the outer volute; and
the inner volute being arranged with the backflow device.
2. The volute structure according to claim 1, wherein the inner volute and the backflow device are casted integrally.
3. The volute structure according to claim 1, wherein the outer volute and the cabinet are casted integrally.
4. The volute structure according to any one of claims 1-3, wherein a connection portion between the inner volute and the outer volute is rounded.
5. The volute structure according to any one of claims 1-3, wherein the volute structure further comprises a curve passage that is fixed on backflow device.

6. The volute structure according to claim 5, wherein the curve passage and the backflow device are casted integrally.
7. A centrifugal compressor, comprising a volute structure according to any one of claims 1-6.
8. The volute structure according to claim 7, wherein the centrifugal compressor also comprises a housing, and the volute structure further comprises a one-stage diffuser; and
wherein the housing, the cabinet, the one-stage diffuser, and the backflow device enclose a one-stage gas supply cavity.
9. The volute structure according to claim 7, wherein the centrifugal compressor is a double-stage or multi-stage centrifugal compressor.
10. A refrigerant device, comprising a centrifugal compressor according to any one of claims 7-9.

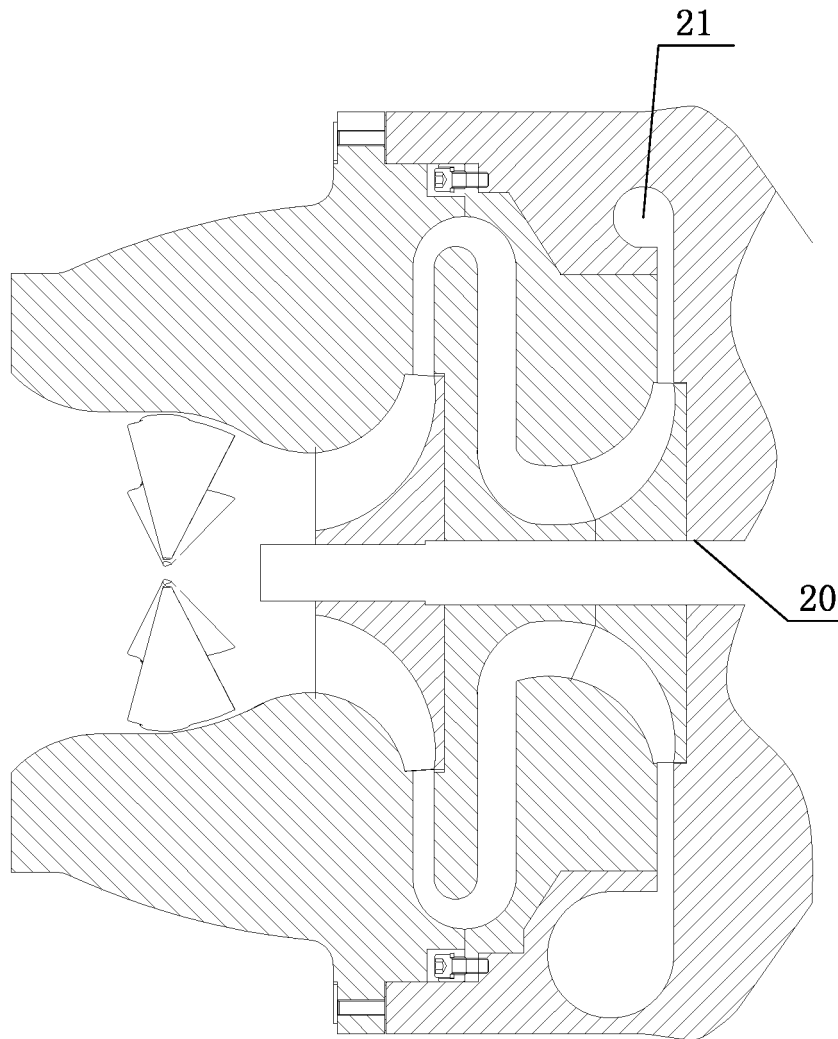


Fig. 1

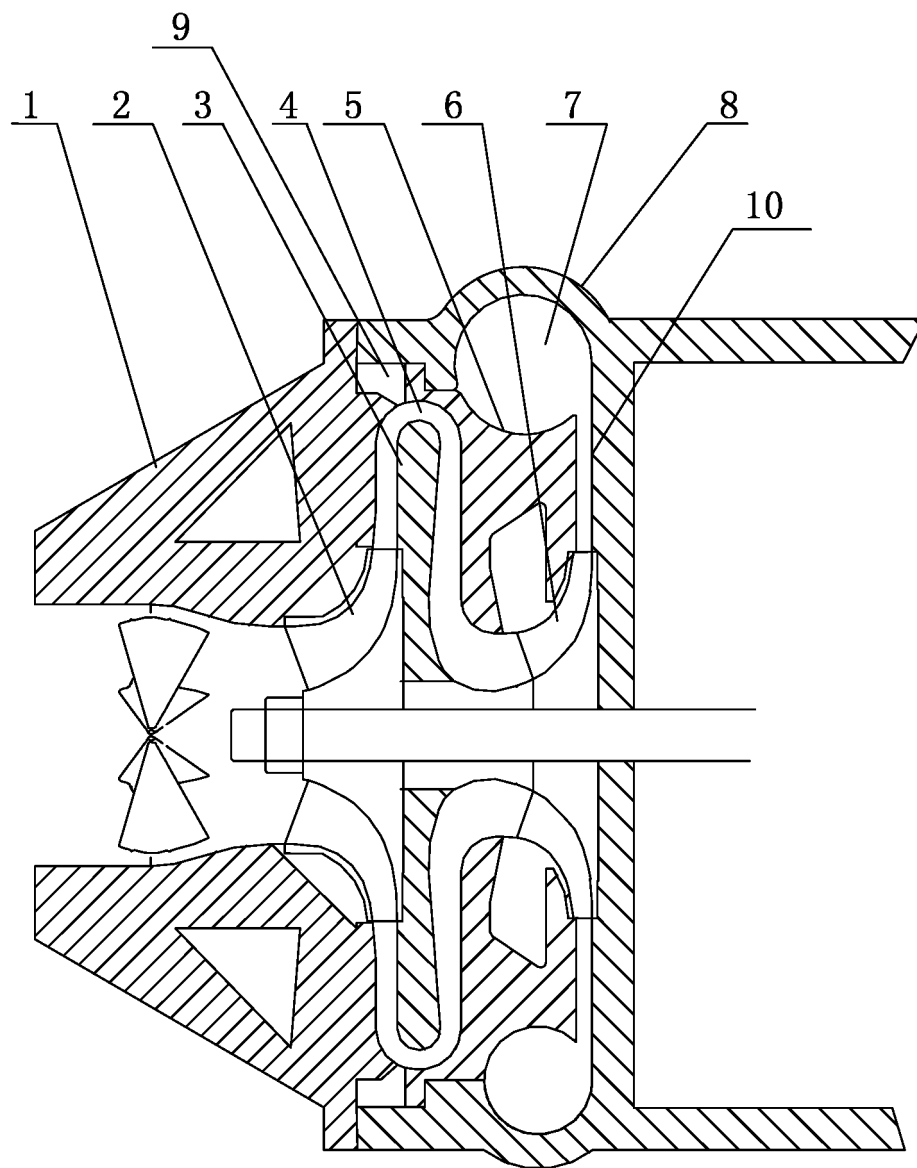


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/095093

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/44 (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)

F04D

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, CNKI, VEN: centrifugal, compressor?, shell, casing, housing, volute, return channel, return device, reflux device

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	CN 204175653 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 25 February 2015 (25.02.2015), see claims 1-10	1-10
A	CN 103016363 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 03 April 2013 (03.04.2013), see description, paragraphs 37-41, and figure 3	1-10
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A	US 6935838 B1 (HI BAR BLOWERS INC.), 30 August 2005 (30.08.2005), see the whole document	1-10
A	WO 2014072288 A1 (NUOVO PIGNONE SRL), 15 May 2014 (15.05.2014), see the whole document	1-10
A	CN 202811531 U (HUNAN HANGXIANG GAS TURBINE CO., LTD.), 20 March 2013 (20.03.2013), see the whole document	1-10

☐ 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
"A" document defining the general state of the art which is not considered to be of particular relevance	
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 26 June 2015 (26.06.2015)	Date of mailing of the international search report 10 July 2015 (10.07.2015)
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 QIN, Baojun Telephone No.: (86-10) 62084087

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT **Information on patent family members**

International application No.

PCT/CN2014/095093

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CN 202811531 U	20 March 2013	None	

REFERENCES CITED IN THE DESCRIPTION

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