US Patent & Trademark Office
Patent Public Search | Text View

United States Patent Application Publication	20250260283
Kind Code	A1
Publication Date	August 14, 2025
Inventor(s)	NITTA; Tatsuya et al.

ROTOR OF ROTARY ELECTRIC MACHINE

Abstract

The rotor of the rotary electric machine includes: a plurality of refrigerant holes formed at intervals in the circumferential direction in the shaft so as to communicate with the shaft center hole; a plurality of refrigerant passages formed at intervals in the circumferential direction in the rotor core so as to extend in the axial direction on the radially outer side of the core center hole; a plurality of communication passages formed at intervals in the circumferential direction in the rotor core so as to communicate with the corresponding refrigerant passages at two different positions in the axial direction while communicating with the corresponding refrigerant holes; and a plurality of stress relaxation slots formed at intervals in the circumferential direction in the rotor core so as to surround the core center hole on the radially inner side of the refrigerant passages without interfering with the communication passages.

Inventors: **NITTA; Tatsuya (Toyota-shi, JP), KATO; Hiroki (Toyota-shi, JP)**

Applicant: **TOYOTA JIDOSHA KAUSHIKI KAISHA** (Toyota-shi, JP)

Family ID: **96630817**

Assignee: **TOYOTA JIDOSHA KAUSHIKI KAISHA (Toyota-shi, JP)**

Appl. No.: **18/938277**

Filed: **November 06, 2024**

Foreign Application Priority Data

JP	2024-018909	Feb. 09, 2024

Publication Classification

Int. Cl.: **H02K1/32** (20060101)

U.S. Cl.:

CPC **H02K1/32** (20130101);

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Patent Application No. 2024-018909 filed on Feb. 9, 2024, incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a rotor of a rotary electric machine, the rotor including a hollow shaft and an annular rotor core fixed to the shaft through interference fitting.

2. Description of Related Art

[0003] Conventionally, there has been known a rotor of a rotary electric machine, the rotor including a shaft having a refrigerant passage and a refrigerant supply port, a rotor core formed by stacking steel plates and fixed to the shaft, and a magnet accommodated in the rotor core (see Japanese Unexamined Patent Application Publication No. 2014-176235 (JP 2014-176235 A), for example). The magnet is accommodated in the rotor core so as to extend in the axial direction. The rotor core of the rotor has a first flow path that extends along the magnet in the vicinity of the magnet, and a second flow path that connects the refrigerant supply port of the shaft and the first flow path. The second flow path is formed symmetrically with respect to the radial direction of the rotor core by second slits provided in the steel plates constituting the central region in the axial direction of the rotor core. The first and second flow paths are merged in the central region in the axial direction of the rotor core to form a refrigerant flow path. With such a rotor of a rotary electric machine, it is possible to supply a cooling medium at a lower temperature to the periphery of the magnet where the temperature becomes high while suppressing a reduction in the strength of the steel plates due to the formation of the slits.

SUMMARY

[0004] Here, in the rotor described above in which the rotor core including the first and second flow paths is fixed to the hollow shaft through interference fitting, it is necessary to suppress a decrease in the interference caused by the centrifugal force during high-speed rotation while relaxing the stress caused by the interference. However, JP 2014-176235 A mentioned above does not disclose or suggest a countermeasure for relaxing the stress caused by the interference or suppressing a decrease in the interference caused by the centrifugal force during high-speed rotation.

[0005] Thus, a main object of the present disclosure is to provide a rotor of a rotary electric machine, the rotor being capable of relaxing the stress caused by the interference and suppressing a decrease in the interference caused by the centrifugal force during high-speed rotation, while cooling a rotor core well.

[0006] An aspect of the present disclosure provides a rotor of a rotary electric machine. The rotor includes a hollow shaft and an annular rotor core fixed to the shaft through interference fitting. The rotor includes: [0007] a plurality of refrigerant holes provided in the shaft at intervals in a circumferential direction so as to communicate with a shaft center hole of the shaft; [0008] a plurality of refrigerant passages provided in the rotor core at intervals in the circumferential direction so as to extend in an axial direction on a radially outer side of a core center hole of the rotor core; [0009] a plurality of communication passages provided in the rotor core at intervals in the circumferential direction so as to communicate with the corresponding refrigerant holes and communicate with the corresponding refrigerant passages at two different locations in the axial direction; and [0010] a plurality of stress relaxation slots provided in the rotor core at intervals in the circumferential direction so as to surround the core center hole on a radially inner side of the refrigerant passages without interfering with the communication passages.

[0011] The rotor of a rotary electric machine according to the present disclosure includes a hollow shaft and an annular rotor core fixed to the shaft through interference fitting. The rotor core includes a plurality of refrigerant passages, a plurality of communication passages, and a plurality of stress relaxation slots. The refrigerant passages are provided in the rotor core at intervals in the circumferential direction so as to extend in the axial direction on the radially outer side of the core center hole of the rotor core. The communication passages are provided in the rotor core at intervals in the circumferential direction so as to communicate with the corresponding refrigerant holes formed in the shaft and communicate with the corresponding refrigerant passages at two different locations in the axial direction. Accordingly, the refrigerant supplied to the shaft center hole of the shaft can be supplied to the refrigerant passages via the refrigerant holes and the communication passages by the centrifugal force, cooling the rotor core well. Further, the stress relaxation slots are provided in the rotor core at intervals in the circumferential direction so as to surround the core center hole on the radially inner side of the refrigerant passages without interfering with the communication passages. Accordingly, it is possible to reduce the stress caused by the interference fitting between the shaft and the rotor core around the core center hole of the rotor core, and to reduce the centrifugal force acting on a portion of the rotating rotor core on the radially inner side of the stress relaxation slots. As a result, with the rotor of a rotary electric machine according to the present disclosure, it is possible to relax the stress caused by the interference and suppress a decrease in the interference caused by the centrifugal force during high-speed rotation, while cooling a rotor core well.

[0012] The refrigerant holes may be provided at intervals in the circumferential direction in a central region in the axial direction of the shaft; the communication passages may be provided at intervals in the circumferential direction in a central region in the axial direction of the rotor core;

[0013] the communication passages may include an inner communication portion that communicates with the refrigerant hole, a pair of outer communication portions provided at intervals in the axial direction so as to communicate with the refrigerant passage, and a pair of intermediate communication portions provided at intervals in the axial direction so as to communicate with the inner communication portion and a corresponding one of the outer communication portions; and [0014] the stress relaxation slots may include a plurality of first slots provided on a radially outer side of the inner communication portion of the communication passages, a plurality of second slots provided between the intermediate communication portions of the communication passages in the circumferential direction, and a plurality of third slots provided on a radially inner side of the outer communication portion of the communication passages.

[0015] Accordingly, the communication passages and the stress relaxation slots can be provided in the rotor core without interfering with each other, and the refrigerant can be smoothly supplied to the refrigerant passages via the communication passages.

[0016] The rotor core may include a plurality of core plates stacked in the axial direction; [0017] the core plates may include [0018] a plurality of first core plates that includes an inner slit that defines the inner communication portion and a first slit that defines the first slot, a plurality of second core plates that includes an intermediate slit that defines the intermediate communication portion and a second slit that defines the second slot, a plurality of third core plates that includes an outer slit that defines the outer communication portion and a third slit that defines the third slot, and [0019] fourth core plates that include a slit that defines the refrigerant passage and a fourth slit that defines the stress relaxation slot; [0020] the second core plates may be stacked on both sides in the axial direction of the first core plates; [0021] the third core plates may be stacked on the second core plates from both sides in the axial direction of the first core plates; and [0022] the fourth core plates may be stacked on the third core plates from both sides in the axial direction of the first core plates.

[0023] Accordingly, it is possible to provide a plurality of refrigerant passages, a plurality of communication passages, and a plurality of stress relaxation slots in a rotor core while ensuring good assemblability of a rotor.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Features, advantages, and technical and industrial significance of exemplary embodiments of the disclosure will be described below with reference to the accompanying drawings, in which like signs denote like elements, and wherein:

[0025] FIG. **1** is a schematic configuration diagram showing a rotor of a rotary electric machine of the present disclosure;

[0026] FIG. **2** is an enlarged cross-sectional view showing a rotor of the rotary electric machine of the present disclosure;

[0027] FIG. **3** is a plan view illustrating a first core plate forming a rotor core of a rotor of a rotary electric machine of the present disclosure;

[0028] FIG. **4** is a plan view illustrating a second core plate forming a rotor core of a rotor of a rotary electric machine of the present disclosure;

[0029] FIG. **5** is a plan view illustrating a third core plate forming a rotor core of a rotor of a rotary electric machine of the present disclosure; and

[0030] FIG. **6** is a plan view illustrating a fourth core plate forming a rotor core of a rotor of the rotary electric machine of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0031] Embodiments of the present disclosure will now be described with reference to the drawings.

[0032] FIG. **1** is a schematic configuration diagram showing a rotor **1** of a rotary electric machine of the present disclosure, and FIG. **2** is an enlarged cross-sectional view of a main part showing the rotor **1**. The rotor **1** shown in these drawings is a so-called embedded magnet-type (IPM type) rotor that constitutes a rotary electric machine (for example, a three-phase AC motor) together with a stator (not shown). As illustrated, the rotor **1** includes a rotor shaft **2**, a rotor core **3** fixed to the rotor shaft **2** by interference fitting such as shrink fitting or press fitting, and a plurality of permanent magnets **4** embedded in the rotor core **3** so as to form a plurality of magnetic poles.

[0033] The rotor shaft **2** is hollow-formed of metal, and is interference-fitted to the core center hole **3***h* of the rotor core **3** so that the enlarged diameter portion **2***e* expanded radially outward from the outer peripheral surface abuts on one end surface of the rotor core **3**. A coolant (for example, hydraulic fluid such as ATF) is supplied from a pump (not shown) to the shaft center hole **2***h* of the rotor shaft **2**. In the central area in the longitudinal direction of the rotor shaft **2**, a plurality of (for example, eight in the present embodiment) refrigerant **30** holes **2***r* are formed at intervals in the circumferential direction. The refrigerant holes **2***r* communicate with the shaft center hole **2***h* of the rotor shaft **2** and open at the outer peripheral surface of the rotor shaft **2**.

[0034] As shown in FIG. **2**, the rotor core **3** is formed by stacking a plurality of first core plates **31**, a plurality of second core plates **32**, a plurality of third core plates **33**, and a plurality of fourth core plates **34** in the axial direction. The rotor core **3** further includes a plurality of refrigerant passages **35** and a plurality of communication passages **36**. The refrigerant passages **35** are formed circumferentially spaced apart from the rotor core **3** so as to extend in the axial direction along the corresponding permanent magnets **4** radially outward of the core center hole **3***h*. Each of the refrigerant passages **35** extends from a central region in the axial direction of the rotor core **3** toward an end face of the corresponding rotor core **3**, and opens at the corresponding end face. Further, the communication passages **36** are formed at intervals in the circumferential direction in the central region in the axial direction of the rotor core **3**. The communication passages **36** include a single inner communication portion **36***i*, a pair of (two) outer communication portions **360**, and a pair of (two) intermediate communication portions **36***m*, and extend stepwise from the core center hole **3***h* of the rotor core **3** toward the outer peripheral side as shown in FIGS. **1** and **2**.

[0035] Each of the first, second, third, and fourth core plates **31**, **32**, **33**, and **34** is formed in an annular shape from an electromagnetic steel sheet by, for example, press working. As shown in FIG. **2**, in the present embodiment, a plurality of second core plates **32** are stacked on both sides in the axial direction of the first core plates **31**. Further, a plurality of third core plates **33** are stacked on the second core plates **32** from both sides in the axial direction of the first core plates **31**. Then, a plurality of fourth core plates **34** are stacked on the third core plates **33** from both sides in the axial direction of the first core plates **31**.

[0036] As shown in FIG. **3**, the first core plate **31** includes a center hole **31***h*, a plurality of magnet slits **31***a*, a plurality of inner slits **31***i*, a plurality of slits **31***x*, and a plurality of first stress relaxation slits **311**. The magnet slits **31***a* are arranged at predetermined intervals (45° intervals in the embodiment) by two. The two magnet slits **31***a* in a pair are formed so as to be spaced apart from each other from the center side toward the outer peripheral side of the first core plate **31** (so as to form a substantially V-shape). The inner slits **31***i* are circumferentially spaced (equally spaced) from the inner peripheral portion of the first core plate **31** so as to communicate (open) with the center hole **31***h*. The slits **31***x* are circumferentially spaced (equally spaced) so as to be located radially outward of the corresponding inner slits **31***i*. The first stress relaxation slits **311** are circumferentially spaced (equally spaced) between the inner slits **31***i* and the slits **31***x* in the radial direction so as to be located radially outward of the part between the inner slits **31***i* adjacent to each other in the circumferential direction.

[0037] As shown in FIG. **4**, the second core plate **32** includes a center hole **32***h*, a plurality of magnet slits **32***a*, a plurality of intermediate slits **32***m*, a plurality of slits **32***y*, and a plurality of second stress relaxation slits **322**. The magnet slits **32***a* are arranged at predetermined intervals (45° intervals in the embodiment) by two. The two magnet slits **32***a* in a pair are formed so as to be spaced apart from each other from the center side toward the outer peripheral side of the second core plate **32** (so as to form a substantially V-shape). The intermediate slits **32***m* are arranged without communicating (opening) with the center hole **32***h*. Further, the intermediate slits **32***m* are arranged at intervals (at equal intervals) in the circumferential direction in the inner peripheral portion of the second core plate **32** so as to partially overlap with the corresponding inner slits **31***i* of the first core plate **31** when viewed from the axial direction. The slits **32***y* are circumferentially spaced (equally spaced) radially outward of the intermediate slits **32***m*. The second stress relaxation slits **322** are arranged at intervals (at equal intervals) in the circumferential direction on the radially inner side of the slits **32***y* so as to be positioned between the intermediate slits **32***m* adjacent to each other in the circumferential direction.

[0038] As shown in FIG. **5**, the third core plate **33** includes a center hole **33***h*, a plurality of magnet slits **33***a*, a plurality of outer slits **330**, and a plurality of third stress relaxation slits **333**. The magnet slits **33***a* are arranged at predetermined intervals (45° intervals in the embodiment) by two. The two magnet slits **33***a* in a pair are formed so as to be spaced apart from each other from the center side toward the outer peripheral side of the third core plate **33** (so as to form a substantially V-shape). The outer slits **330** are circumferentially spaced (equally spaced) radially inward of the magnet slits **33***a* so as to partially overlap the corresponding intermediate slits **32***m* of the third core plate **33** when viewed from the axial direction. The third stress relaxation slits **333** are arranged radially inward of the part between the outer slit **330** adjacent to each other in the circumferential direction and circumferentially spaced (equally spaced) along the center hole **33***h*.

[0039] As shown in FIG. **6**, the fourth core plate **34** includes a center hole **34***h*, a plurality of magnet slits **34***a*, a plurality of slit **34***z*, and a plurality of fourth stress relaxation slits **344**. The magnet slits **34***a* are arranged at predetermined intervals (45° intervals in the embodiment) by two.

The two magnet slits **34***a* in a pair are formed so as to be spaced apart from each other from the center side toward the outer peripheral side of the fourth core plate **34** (to form a substantially V-shape). The slit **34***z* are circumferentially spaced (equally spaced) radially inward of the magnet slits **34***a* so as to at least partially overlap the corresponding outer slit **330** of the third core plate **33** when viewed from the axial direction. The fourth stress relaxation slits **344** are circumferentially spaced (equally spaced) along the center hole **34***h*.

[0040] When a plurality of first, second, third and fourth core plates **31**, **32**, **33** and **34** are axially stacked, respectively, the center hole **31***h*, **32***h*, **33***h*, **34***h* defines the core center hole **3***h* of the rotor core **3**. Further, when the first, second, third and fourth core plates **31**, **32**, **33**, **34** are axially stacked, respectively, the magnet slits **31***a*, **32***a*, **33***a*, **34***a* overlapping each other defines a magnet holding portion for holding the permanent magnet **4**.

[0041] In addition, when the first core plates **31** are axially stacked, the inner slits **31***i* overlapping each other define an inner communication portion **36***i* of the communication passage **36**, and the slits **31***x* overlapping each other define a slot **36***x* (see FIG. **2**) located radially outward of the inner communication portion **36***i*. Further, when the second core plates **32** are axially stacked, the overlapping intermediate slits **32***m* define an intermediate communication portion **36***m* of the communication passage **36**, and the overlapping slits **32***y* define a slot **36***y* (see FIG. **2**) located radially outward of the intermediate communication portion **36***m*. In addition, when the third core plates **33** are axially stacked, the outer slits **330** overlapping each other define an outer communication portion **360** of the communication passage **36**, and when the fourth core plates **34** are axially stacked, the slit **34***z* overlapping each other define the refrigerant passage **35**.

[0042] As shown in FIG. **2**, the inner communication portions **36***i* of the respective communication passages **36** communicate with the corresponding refrigerant holes **2***r*. In addition, the pair of outer communication portions **360** of the respective communication passages **36** communicate with the corresponding refrigerant passages **35**. Further, the pair of intermediate communication portions **36***m* of the respective communication passages **36** communicate with corresponding ones of the inner communication portion **36***i* and the pair of outer communication portions **360**, respectively. As a result, the communication passages **36** communicate with the corresponding refrigerant holes **2***r* formed in the rotor shaft **2** and communicate with the corresponding refrigerant passages **35** at two different axial positions of the rotor shaft **2**. Further, the pair of outer communication portions **360** communicate with each other via a slot **36***x* formed on the radially outer side of the inner communication portion **36***i* and a slot **36***y* formed on the radially outer side of the respective intermediate communication portions **36***m*.

[0043] Further, when the first core plates **31** are axially stacked, the overlapping first stress relaxation slits **311** define first stress relaxation slots **301**. The first stress relaxation slot **301** is defined radially outward of the part between the circumferentially adjacent inner communication portions **36***i* and radially inward of the refrigerant passages **35**. Further, when the second core plates **32** are axially stacked, the second stress relaxation slits **322** overlapping each other define the second stress relaxation slots **302** between the intermediate communication portions **36***m* adjacent to each other in the circumferential direction. Further, when the third core plates **33** are axially stacked, the third stress relaxation slits **333** overlapping each other define a third stress relaxation slot **303** radially inward of the part between the outer communication portions **360** adjacent to each other in the circumferential direction. Further, when the fourth core plates **34** are axially stacked, the fourth stress relaxation slits **344** overlapping each other define the fourth stress relaxation slots **304** so as to be aligned in the circumferential direction along the core center hole **3***h*. Thus, a plurality of first, second, third, and fourth stress relaxation slots **301-304** are formed in the rotor core **3** without interfering with the communication passages **36**. Each of the first, second, third, and fourth stress relaxation slots **301-304** is circumferentially spaced to surround the core center hole **3***h* radially inward of the refrigerant passages **35**.

[0044] As described above, the rotor **1** of the rotary electric machine includes the hollow rotor shaft

2 and the annular rotor core **3** fixed to the rotor shaft **2** by an interference fit. The rotor core **3** includes a plurality of refrigerant passages **35** and a plurality of communication passages **36**. The refrigerant passages **35** are formed circumferentially spaced apart from each other in the rotor core **3** so as to extend in the axial direction radially outward of the core center hole **3***h* of the rotor core **3**. Further, the communication passages **36** are formed circumferentially spaced apart from each other in the rotor core **3** so as to communicate with the corresponding refrigerant holes **2***r* formed in the rotor shaft **2** and communicate with the corresponding refrigerant passages **35** at two different positions in the axial direction.

[0045] As a result, when the rotor **1** is rotating, the coolant supplied to the shaft center hole **2***h* of the rotor shaft **2** flows from the refrigerant holes **2***r* to the inner communication portions **36***i* of the respective communication passages **36**. The lubricating cooling medium flowing into the inner communication portions **36***i* flows into the corresponding refrigerant passages **35** and slotted **36***x*, **36***y* via the pair of intermediate communication portions **36***m* and the pair of outer communication portions **360**. As a result, the respective permanent magnets **4** and thus the entire rotor core **3** can be satisfactorily cooled by the cooling medium flowing through the refrigerant passages **35** and the like. The cooling medium removes heat from the rotor core **3**, flows out from the opening of each refrigerant passage **35** formed in the end face of the rotor core **3**, and scatters radially outward by centrifugal force. The cooling medium scattered to the outside of the rotor core **3** is recovered in the case of the rotary electric machine, cooled by a cooler (not shown), and then supplied again to the rotor core **3** by the pump.

[0046] Further, the rotor core **3** includes a plurality of first, second, third, and fourth stress relaxation slots **301-304**, respectively. The first, second, third, and fourth stress relaxation slots **301-304** are circumferentially spaced so as to surround the core center hole **3***h* radially inward of the refrigerant passages **35** without interfering with the communication passages **36**. As a result, it is possible to reduce the stresses generated by the interference fit between the rotor shaft **2** and the rotor core **3** around the core center hole **3***h* of the rotor core **3**. The centrifugal force acting on the radially inner portions of the first, second, third, and fourth stress relaxation slots **301-304** of the rotating rotor core **3** can then be reduced. As a result, in the rotor **1**, it is possible to reduce the stress caused by the interference while cooling the rotor core **3** satisfactorily, and to suppress the decrease in the interference caused by the centrifugal force during high rotation.

[0047] Further, in the rotor **1**, the refrigerant holes **2***r* are formed at intervals in the circumferential direction in the central region in the axial direction of the rotor shaft **2**, and the communication passages **36** are formed at intervals in the circumferential direction in the central region in the axial direction of the rotor core **3**. Further, the communication passages **36** each include an inner communication portion **36***i* communicating with the corresponding refrigerant hole **2***r*, a pair of outer communication portions **360** formed at intervals in the axial direction so as to communicate with the corresponding refrigerant passages **35**, and a pair of intermediate communication portions **36***m* formed at intervals in the axial direction so as to communicate with the corresponding one of the inner communication portion **36***i* and the pair of outer communication portions **360**, respectively. Further, the first stress relaxation slots **301** are formed on the radially outer side of the inner communication portion **36***i* of the communication passages **36**, the second stress relaxation slots **302** are formed between the intermediate communication portions **36***m* of the communication passages **36** in the circumferential direction, and the third stress relaxation slots **303** are formed on the radially inner side of the outer communication portion **360** of the communication passages **36**. As a result, the communication passages **36** and the first, second, and third stress relaxation slots **301-303** are formed in the rotor core **3** without interfering with each other, and the refrigerant can be smoothly supplied to each of the refrigerant passages **35** via the communication passages **36**.

[0048] Further, the rotor core **3** is formed by laminating a plurality of first core plates **31**, a plurality of second core plates **32**, a plurality of third core plates **33**, and a plurality of fourth core plates **34** in the axial direction. That is, the second core plates **32** are stacked on both sides in the

axial direction of the first core plates **31**, and the third core plates **33** are stacked on the second core plates **32** from both sides in the axial direction of the first core plates **31**. Further, a plurality of fourth core plates **34** are stacked on the third core plates **33** from both sides in the axial direction of the first core plates **31**. The first core plate **31** also includes an inner slit **31***i* defining an inner communication portion **36***i* and a first stress relaxation slit **311** defining a first stress relaxation slot **301**. The second core plate **32** includes an intermediate slit **32***m* defining an intermediate communication portion **36***m* and a second stress relaxation slit **322** defining a second stress relaxation slot **302**. Further, the third core plate **33** includes an outer slit **330** defining an outer communication portion **360** and a third stress relaxation slit **333** defining a third stress relaxation slot **303**. The fourth core plate **34** includes a slit **34***z* defining a refrigerant passage **35** and a fourth stress relaxation slit **344** defining a fourth stress relaxation slot **304**. This makes it possible to form the refrigerant passages **35**, the communication passages **36**, and the first, second, third, and fourth stress relaxation slots **301**-**304** in the rotor core **3**, respectively, while ensuring good assemblability of the rotor **1**.
[0049] The cross-sectional shapes of the inner slit **31***i* and the first stress relaxation slit **311** of the first core plate **31**, the intermediate slit **32***m* and the second stress relaxation slit **322** of the second core plate **32**, the outer slit **330** and the third stress relaxation slit **333** of the third core plate **33**, and the slit **34***z* and the fourth stress relaxation slit **344** of the fourth core plate **34** are not limited to those illustrated in FIGS. **3** to **6**. It goes without saying that any cross-sectional shape can be adopted for these slits depending on the specifications of the rotor core **3** and the like.
[0050] In addition, the disclosure of the present disclosure is not limited to the above-described embodiments, and it is needless to say that various modifications can be made within the scope of the extension of the present disclosure. Furthermore, the above-described embodiment is only a specific form of the disclosure described in the column of the outline of the disclosure, and does not limit the elements of the disclosure described in the column of the outline of the disclosure.
[0051] The disclosure of the present disclosure can be used in a manufacturing industry of a rotary electric machine and the like.

Claims

1. A rotor of a rotary electric machine, the rotor including a hollow shaft and an annular rotor core fixed to the shaft through interference fitting, and the rotor comprising: a plurality of refrigerant holes provided in the shaft at intervals in a circumferential direction so as to communicate with a shaft center hole of the shaft; a plurality of refrigerant passages provided in the rotor core at intervals in the circumferential direction so as to extend in an axial direction on a radially outer side of a core center hole of the rotor core; a plurality of communication passages provided in the rotor core at intervals in the circumferential direction so as to communicate with the corresponding refrigerant holes and communicate with the corresponding refrigerant passages at two different locations in the axial direction; and a plurality of stress relaxation slots provided in the rotor core at intervals in the circumferential direction so as to surround the core center hole on a radially inner side of the refrigerant passages without interfering with the communication passages.
2. The rotor of a rotary electric machine according to claim 1, wherein: the refrigerant holes are provided at intervals in the circumferential direction in a central region in the axial direction of the shaft; the communication passages are provided at intervals in the circumferential direction in a central region in the axial direction of the rotor core; the communication passages include an inner communication portion that communicates with the refrigerant hole, a pair of outer communication portions provided at intervals in the axial direction so as to communicate with the refrigerant passage, and a pair of intermediate communication portions provided at intervals in the axial direction so as to communicate with the inner communication portion and a corresponding one of the outer communication portions; and the stress relaxation slots include a plurality of first slots

provided on a radially outer side of the inner communication portion of the communication passages, a plurality of second slots provided between the intermediate communication portions of the communication passages in the circumferential direction, a plurality of third slots provided on a radially inner side of the outer communication portion of the communication passages, and a plurality of fourth slots provided so as to be aligned in the circumferential direction along the core center hole in a region other than the central region of the rotor core.

3. The rotor of a rotary electric machine according to claim 2, wherein: the rotor core includes a plurality of core plates stacked in the axial direction; the core plates include a plurality of first core plates that includes an inner slit that defines the inner communication portion and a first slit that defines the first slot, a plurality of second core plates that includes an intermediate slit that defines the intermediate communication portion and a second slit that defines the second slot, a plurality of third core plates that includes an outer slit that defines the outer communication portion and a third slit that defines the third slot, and fourth core plates that include a slit that defines the refrigerant passage and a fourth slit that defines the fourth slot; the second core plates are stacked on both sides in the axial direction of the first core plates; the third core plates are stacked on the second core plates from both sides in the axial direction of the first core plates; and the fourth core plates are stacked on the third core plates from both sides in the axial direction of the first core plates.