AIR-COOLED NOISE-REDUCING STATOR CORE STRUCTURE AND TRACTION ELECTRIC MOTOR

TECHNICAL FIELD

[0001] The disclosure belongs to the technical field of noise reduction of air-cooled electric motors, and particularly relates to an air-cooled noise-reducing stator core structure and a traction electric motor.

BACKGROUND

[0002] When the electric motor operates, large amount of heat may be generated, which may result in increase in internal temperature and affect its service life, and thus it is necessary to provide a corresponding cooling structure for cooling. Currently, commonly used cooling modes involves oil cooling, water cooling and air cooling, and a corresponding cooling mode may be selected according to cooling demand, cost and scene limitation of an electric motor in design.

[0003] For air-cooled electric motors, in order to improve heat dissipation effect, air ducts are provided on a stator core. These air ducts are usually circular, elliptical, or rectangular with rounded corners or in other shapes in cross section, and are arranged along a circumferential direction of the stator core. A flow sequence of air flow in the electric motor is to pass through an air inlet of the electric motor, the air ducts on the stator core and an air outlet of the electric motor in turn, thus effectively taking away heat inside the electric motor.

[0004] However, there may be some aerodynamic noise in operations of the air-cooled electric motor. Energy of the aerodynamic noise mainly originates from a fan, and the aerodynamic noise generated by the fan may spread along a cooling airflow. For a case where the fan is installed inside the electric motor, the fan is a biggest source of the aerodynamic noise, and acoustic energy may radiate out of the electric motor through the air inlet and the air outlet, thus with large noise especially for a traction electric motor in rail transit, which may on one hand pollute an acoustic environment in an area where a vehicle passes, and on the other hand, also affect ride comfort of passengers in the vehicle.

SUMMARY

[0005] A technical problem to be solved by the disclosure is to provide an air-cooled noise-reducing stator core structure and a traction electric motor with reduced aerodynamic noise

and higher reliability while ensuring air-cooling heat dissipation effect.

[0006] The disclosure provides an air-cooled noise-reducing stator core structure, which includes two end lamination modules and a middle lamination module. Each of the two end lamination modules includes more than one end lamination, and all of end laminations are each provided with a first air hole, and the middle lamination module includes more than one first middle lamination and more than one second middle lamination, and all of first middle laminations are each provided with a second air hole and a third air hole, the second air hole is communicated with the third air hole, and all of second middle laminations are each provided with a fourth air hole and a fifth air hole, the fourth air hole is separated from the third air hole.

[0007] The middle lamination module is arranged between the two end lamination modules, and the first middle lamination and the second middle lamination are arranged to be overlapped between the two end lamination modules. The first air hole, the second air hole and the fourth air hole are communicated to form a main air duct, and the third air hole and the fifth air hole are communicated to form a branch air duct, and the branch air duct is communicated with the main air duct through a communication part of the second air hole and the third air hole.

[0008] Further, an overlapping arrangement mode of the first middle lamination and the second middle lamination is as follows: there are more than two first middle laminations, all of the more than two first middle laminations are divided into two groups, all of second middle laminations are located between the two groups of first middle laminations, and two ends of the branch air duct are each communicated with the main air duct through the communication part of the second air hole and the third air hole.

[0009] Further, the fifth air hole includes n air sub-holes, where n is an odd number and greater than or equal to 3, and each of first middle laminations is provided with a sixth air hole, the sixth air hole is located at a side of the third air hole and separated from the second air hole and the third air hole, and a number of sixth air holes on the first middle laminations corresponding to the fifth air hole is half of n-1. The third air holes of one of the two groups of first middle laminations is aligned and communicated with one of the air sub-holes, and the sixth air hole is aligned and communicated with two adjacent air sub-holes, and the two groups of first middle laminations are arranged in a mirror pattern. The n air sub-holes of the fifth air hole on of all of the second middle laminations are communicated with each other through the sixth air hole and communicated with the third air hole to form a serpentine branch air duct.

[0010] Further, an overlapping arrangement mode of the first middle lamination and the second middle lamination is as follows: there are more than two second middle laminations, all of the more than two second middle laminations are divided into two groups, all of first middle laminations are located between the two groups of second middle laminations, and the branch air duct is cavity-shaped and is communicated with the main air duct through one communication part of the second air hole and the third air hole.

[0011] Further, an overlapping arrangement mode of the first middle lamination and the second middle lamination is as follows: all of first middle laminations and all of second middle laminations are respectively divided into two groups, the two groups of first middle laminations and the two groups of second middle laminations are arranged alternately, and the branch air duct is cavity-shaped and is communicated with the main air duct through more than two communication parts of the second air hole and the third air hole.

[0012] Further, the third air hole is located at a side of the second air hole away from an axis of the first middle lamination, and the fifth air hole is located at a side of the fourth air hole away from an axis of the second middle lamination.

[0013] Further, the single middle lamination module and the two end lamination modules form a stator core subunit, and there are more than two stator core subunits which are axially arranged, and two adjacent stator core subunits share one end lamination module.

[0014] Further, overlapping arrangement modes of the first middle laminations and the second middle laminations in all of stator core subunits are same, or overlapping arrangement modes of the first middle laminations and the second middle laminations in at least two stator core subunits are different from each other.

[0015] Further, there are a plurality of first air holes, a plurality of second air holes, a plurality of third air holes, a plurality of fourth air holes and a plurality of fifth air holes. The plurality of first air holes are circumferentially arranged on the end lamination, the plurality of second air holes and the plurality of third air holes are circumferentially arranged on the first middle lamination, and the plurality of fourth air holes and the plurality of fifth air holes are circumferentially arranged on the second middle lamination.

[0016] The disclosure further provides a traction electric motor provided with the air-cooled noise-reducing stator core structure described above.

[0017] The disclosure has beneficial effects that two layers of air ducts can be formed on the stator core, the main air duct forms a main flow path of a cooling air flow, the cooling air flow is not subjected to additional transport resistance in the main air duct, and a substantial cooling air flow does not necessarily flows through an interior of the branch air duct which

is mainly a sound propagation channel so as to form a silencing structure, thus effectively reducing aerodynamic noise without weakening ventilation and air-cooling heat dissipation effect. Meanwhile, this double-layer air duct structure may also increase disturbance of the cooling air flow and increase a heat exchange area, thereby further improving heat dissipation of the electric motor. Additionally, the air cooling channel is formed by the stator core structure while a noise reduction and silencing structure is formed without using a porous sound absorption material, thus with better performance of high temperature resistance, moisture resistance, aging resistance and the like and better reliability. When it is applied to the traction electric motor in rail transit, acoustic environment pollution in the area where the vehicle passes can be effectively reduced and ride comfort of passengers in the vehicle can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG.1 is a schematic structural view of an end lamination according to the present disclosure.

[0019] FIG.2 is a schematic structural view of a first embodiment of a first middle lamination according to the present disclosure.

[0020] FIG.3 is a schematic structural view of a mirrored first middle lamination of FIG. 2 according to the present disclosure.

[0021] FIG.4 is a schematic structural view of a second embodiment of the second middle lamination according to the present disclosure.

[0022] FIG.5 is a schematic exploded view of a first embodiment of an air-cooled noise-reducing stator core structure according to the present disclosure.

[0023] FIG.6 is a schematic view of a main air duct and a branch air duct stacked in a stacking mode of FIG. 5 according to the present disclosure.

[0024] FIG.7 is a schematic structural view of a second embodiment of the first middle lamination according to the present disclosure.

[0025] FIG.8 is a schematic structural view of a second embodiment of the second middle lamination according to the present disclosure.

[0026] FIG.9 is a schematic sectional view of a second embodiment of the air-cooled noise-reducing stator core structure according to the present disclosure.

[0027] FIG.10 is a schematic sectional view of a third embodiment of the air-cooled noise-reducing stator core structure according to the present disclosure.

[0028] FIG.11 is a schematic sectional view of a fourth embodiment of the air-cooled noise-

reducing stator core structure according to the present disclosure.

[0029] Reference numbers are as follows: 1. End Lamination; 11. First Air Hole; 2. First Middle Lamination; 21. Second Air Hole; 22. Third Air Hole; 23. Sixth Air Hole; 24. Slit; 3. Second Middle Lamination; 31. Fourth Air Hole; 32. Fifth Air Hole; 321. Air Sub-hole; 10. End Lamination Stack; 20. First Middle Lamination Stack; 30. Second Middle Lamination Stack; 100. Main Air Duct; 200. Branch Air Duct.

DETAILED DESCRIPTION

[0030] In As shown in FIGS. 1 to 11, the disclosure provides an air-cooled noise-reducing stator core structure, which includes two end lamination modules and a middle lamination module. Each of the two end lamination modules includes more than one end lamination 1, that is, the end lamination module is composed of one end lamination 1 or is formed by stacking more than two end laminations 1, all of end laminations 1 are each provided with a first air hole 11. The middle lamination module includes more than one first middle lamination 2 and more than one second middle lamination 3, that is, the middle lamination module is formed by stacking the more than one first middle lamination 2 and the more than one second middle lamination 3. All of first middle laminations 2 are each provided with a second air hole 21 and a third air hole 22, the second air hole 21 is communicated with the third air hole 22, and all of second middle laminations 3 are each provided with a fourth air hole 31 and a fifth air hole 32, the fourth air hole 31 is separated from the third air hole 32.

[0031] The middle lamination module is arranged between the two end lamination modules, the middle lamination module and the two end lamination modules are on a same axis, and the first middle lamination 2 and the second middle lamination 3 are arranged to be overlapped between the two end lamination modules. The first air hole 11, the second air hole 21 and the fourth air hole 31 are communicated to form a main air duct 100, and the third air hole 22 and the fifth air hole 32 are communicated to form a branch air duct 200, and the branch air duct 200 is communicated with the main air duct 100 through a communication part of the second air hole 21 and the third air hole 22.

[0032] Based on the structural arrangement described above, two layers of air ducts can be formed on the stator core, the main air duct 100 forms a main flow path of a cooling air flow, the cooling air flow is not subjected to additional transport resistance in the main air duct 100, and a substantial cooling air flow does not necessarily flows through an interior of the branch air duct 200 which is mainly a sound propagation channel so as to form a silencing structure, thus effectively reducing aerodynamic noise without weakening ventilation and

air-cooling heat dissipation effect. Meanwhile, this double-layer air duct structure may also increase disturbance of the cooling air flow and increase a heat exchange area, thereby further improving heat dissipation of the electric motor. Additionally, the air cooling channel is formed by the stator core structure while a noise reduction and silencing structure is formed without using a porous sound absorption material, thus with better performance of high temperature resistance, moisture resistance, aging resistance and the like and better reliability. When it is applied to the traction electric motor in rail transit, acoustic environment pollution in the area where the vehicle passes can be effectively reduced and ride comfort of passengers in the vehicle can be improved.

[0033] A size of the first air hole 11 is not larger than that of the second air hole 21 and that of the fourth air hole 31. When the first air hole 11 is aligned and communicated with the second air hole 21 and the fourth air hole 31, an area outside the first air hole 11 on the end lamination 1 can effectively block and close a side face of the third air hole 22, and preferably, the size of the first air hole 11 is the same as that of the second air hole 21 and that of the fourth air hole 31.

[0034] In a first embodiment of the present disclosure, an overlapping arrangement mode of the first middle lamination 2 and the second middle lamination 3 is as follows: there are more than two first middle laminations 2, all of the more than two first middle laminations 2 are divided into two groups, all of second middle laminations 3 are located between the two groups of first middle laminations 2, and two ends of the branch air duct 200 are each communicated with the main air duct 100 through the communication part of the second air hole 21 and the third air hole 22. In this embodiment, the branch air duct 200 forms a parallel duct structure with a certain length with the main air duct 100.

[0035] In the first embodiment, preferably the first middle lamination 2 adopts a structure shown in FIGS. 2 and 3, and the second middle lamination 3 adopts a structure shown in FIG. 4. The fifth air hole 32 includes n air sub-holes 321, where n is an odd number and greater than or equal to 3, and each of first middle laminations 2 is provided with a sixth air hole 23, the sixth air hole 23 is located at a side of the third air hole 22 and separated from the second air hole 21 and the third air hole 22, and a number of sixth air holes 23 on the first middle laminations 2 corresponding to the fifth air hole 32 is half of n-1. The third air holes 22 of one of the two groups of first middle laminations 2 is aligned and communicated with one of the air sub-holes 321, and the sixth air hole 23 is aligned and communicated with two adjacent air sub-holes 321, and the two groups of first middle laminations 2 are arranged in a mirror pattern. The n air sub-holes 321 of the fifth air hole 32 on of all of the second middle

laminations 3 are communicated with each other through the sixth air hole 23 and communicated with the third air hole 22 to form a serpentine branch air duct 200.

[0036] Illustration is made by taking a number of air sub-holes 321 in the fifth air hole 32 being 3 and a number of sixth air holes 23 corresponding to one fifth air hole 32 being 1 as an example. As shown in FIG. 1 to 6, two end lamination stacks 10 are the two end lamination modules, two first middle lamination stacks 20 are the two groups of first middle laminations 2 described above, and a second middle lamination stack 30 is formed by stacking all of the second middle laminations 3. The first air holes 11 on the two end lamination stacks 10, the second air holes 21 on the two first middle lamination stacks 20 and the third air hole 22 on the second middle lamination stack 30 are aligned and communicated to form the main air duct 100. The third air hole 22 on a left first middle lamination stack 20 is aligned with one of the air sub-holes 321, and the sixth air hole 23 is aligned with the other two air sub-holes 321 at the same time. The two first middle lamination stacks 20 are arranged in a mirror pattern, and thus an alignment state between the third air hole 22 and the sixth air hole 23 on a right first middle lamination stack 20 is opposite to that on the left first middle lamination stack 20. A double-layer air duct structure in a shape as shown in FIG. 6 can be formed inside the stator core after stacking and sticking the first air holes 11 on the two end lamination stacks 10, the second air holes 21 on the two first middle lamination stacks 20 and the second middle lamination stack 30.

[0037] Based on the above arrangement, the branch air duct 200 is connected in parallel with and at a side of the main air duct 100 in a serpentine channel structure, and a propagation distance of sound waves in the branch air duct 200 is different from that of the main air duct 100, thus forming a coherent sound source different from that of the main air duct 100, and when these sounds meet again, coherent silencing effect may occur, which can weaken noise in a specific frequency band. By adjusting numbers of various laminations described above, different combined sizes can be obtained, and thus length difference between the branch air duct 200 and the main air duct 100 can be changed, thus changing a value of a cancellation frequency, so as to weaken peak in the noise spectrum in a targeted manner. In addition, provision of the serpentine channel structure can increase flow resistance of the cooling air flow in the branch air duct 200 and reduce air flow entering the branch air duct 200 without affecting sound wave transmission, so that impurities from the cooling air flow can be reduced from entering the branch passage and forming of blockage can be avoided, thus with good adaptability to application scenarios with dust pollution.

[0038] In a second embodiment of the present disclosure, preferably the first middle

lamination 2 adopts a structure shown in FIG. 7 and the second middle lamination 3 adopts a structure shown in FIG. 8. An overlapping arrangement mode of the first middle lamination 2 and the second middle lamination 3 is as follows: there are more than two second middle laminations 3, all of the more than two second middle laminations 3 are divided into two groups, all of first middle laminations 2 are located between the two groups of second middle laminations 3, and the branch air duct 200 is cavity-shaped and is communicated with the main air duct 100 through one communication part of the second air hole 21 and the third air hole 22. A number of all of first middle laminations 2 is preferably less than that of second middle laminations 3 in one group.

[0039] In the second embodiment, a slit 24 is formed at a communication part of the second air hole 21 and the third air hole 22 at a separation between the branch air duct 200 and the main air duct 100, and the branch air duct 200 forms a front-rear closed resonant cavity. The resonant cavity is communicated with the main air duct 100 through one slit 24, and sound waves resonate through the resonant cavity and the slit 24, and the sound waves may be subjected to additional dissipation to be converted into heat energy through a boundary of the slit 24, thus achieving noise reduction and silencing.

[0040] In a third embodiment of the present disclosure, preferably the first middle lamination 2 adopts a structure shown in FIG. 7 and the second middle lamination 3 adopts a structure shown in FIG. 8. An overlapping arrangement mode of the first middle lamination 2 and the second middle lamination 3 is as follows: all of first middle laminations 2 and all of second middle laminations 3 are respectively divided into two groups, the two groups of first middle laminations 2 and the two groups of second middle laminations 3 are arranged alternately, and the branch air duct 200 is cavity-shaped and is communicated with the main air duct 100 through more than two communication parts of the second air hole 21 and the third air hole 22.

[0041] In the third embodiment, as shown in FIG. 10, more than two slits 24 are formed at a communication part of the second air hole 21 and the third air hole 22 at a separation between the branch air duct 200 and the main air duct 100, and the branch air duct 200 forms a front-rear closed resonant cavity. The resonant cavity is communicated with the main air duct 100 through more than two slits 24, and sound waves resonate through the resonant cavity and the slit 24, and the sound waves may be subjected to additional dissipation to be converted into heat energy through a boundary of the slit 24, thus achieving noise reduction and silencing. A number of slits 24 can be determined according to actual noise reduction requirements.

[0042] Preferably, the third air hole 22 is located at a side of the second air hole 21 away from an axis of the first middle lamination 2, and the fifth air hole 32 is located at a side of the fourth air hole 31 away from an axis of the second middle lamination 3. That is, the branch air duct 200 is located at an outer side of the main air duct 100 on the stator core structure, which does not increase internal heat transfer resistance of the electric motor and does not affect overall cooling performance of the structure.

[0043] In a provision mode of the disclosure, the single middle lamination module and the two end lamination modules form an independent stator core structure and are used independently. For example, the stator core structure of any one of the above first through third embodiments is used independently in an electric motor.

[0044] In another provision mode of the disclosure, the single middle lamination module and the two end lamination modules form a stator core subunit, and there are more than two stator core subunits which are axially arranged, and two adjacent stator core subunits share one end lamination module. That is, the more than two stator core subunits are connected in series and then used in a same electric motor. In this provision mode, overlapping arrangement modes of the first middle laminations 2 and the second middle laminations 3 in all of stator core subunits are same, or overlapping arrangement modes of the first middle laminations 2 and the second middle laminations 3 in at least two stator core subunits are different from each other. That is, combination of two stator core subunits in a same embodiment or combination of two stator core subunits in different embodiments can be used in the electric motor. Arrangement and combination of various stacking schemes can be used to significantly improve an effective frequency range of noise reduction, with significant effect on weakening mid-low frequency noise sensitive to human ears.

[0045] As shown in FIG. 9, combination of a plurality of stator core subunits according to the second embodiment of the present disclosure is adopted. Two adjacent stator core subunits share one end lamination module, and resonant cavities on the two adjacent stator core subunits are separated by the end lamination module, and main air ducts 100 on the two adjacent stator core subunits are aligned and communicated with each other, with each slit 24 corresponding to one resonant cavity.

[0046] As shown in FIG. 10, combination of stator core units according to the second embodiment and the third embodiment of the present disclosure is adopted. Two adjacent stator core subunits share one end lamination module, and resonant cavities on the two adjacent stator core subunits are separated by the end lamination module, and main air ducts 100 on the two adjacent stator core subunits are aligned and communicated with each other.

[0047] Through combination of different numbers of stacks in the second embodiment and the third embodiment or in the second embodiment and the third embodiment, structures with different resonant frequencies can be formed, and acoustic power can be dissipated by interaction between resonant sound waves passing through the slit 24 and the boundary and converted into heat energy to meet noise reduction requirements at different frequencies.

[0048] There are a plurality of first air holes 11, a plurality of second air holes 21, a plurality of third air holes 22, a plurality of fourth air holes 31 and a plurality of fifth air holes 32. The plurality of first air holes 11 are circumferentially arranged on the end lamination 1, the plurality of second air holes 21 and the plurality of third air holes 22 are circumferentially arranged on the first middle lamination 2, and the plurality of fourth air holes 31 and the plurality of fifth air holes 32 are circumferentially arranged on the second middle lamination 3, thereby improving distribution uniformity of the double-layer air duct structure and improving heat dissipation uniformity of the stator core. When the first middle lamination 2 is provided with the sixth air hole 23, the sixth air holes 23 corresponding to one fifth air hole 32 form a group, and there are plurality of groups of sixth air holes 23 correspondingly provided and circumferentially arranged on the first middle lamination 2.

[0049] The disclosure further provides a traction electric motor provided with the air-cooled noise-reducing stator core structure described above. Due to provision of the stator core structure described above, two layers of air ducts can be formed on the stator core, the main air duct 100 forms a main flow path of a cooling air flow, the cooling air flow is not subjected to additional transport resistance in the main air duct 100, and a substantial cooling air flow does not necessarily flows through an interior of the branch air duct 200 which is mainly a sound propagation channel so as to form a silencing structure, thus effectively reducing aerodynamic noise without weakening ventilation and air-cooling heat dissipation effect. Meanwhile, this double-layer air duct structure may also increase disturbance of the cooling air flow and increase a heat exchange area, thereby further improving heat dissipation of the electric motor. Additionally, the air cooling channel is formed by the stator core structure while a noise reduction and silencing structure is formed without using a porous sound absorption material, thus with better performance of high temperature resistance, moisture resistance, aging resistance and the like and better reliability. Acoustic environment pollution in the area where the vehicle passes can be effectively reduced and ride comfort of passengers in the vehicle can be improved.

[0050] It should be understood by those of ordinary skilled in the art that discussion of any of the above embodiments is only exemplary, and is not intended to imply that the protection

scope of the disclosure is limited to these examples; under the concept of this disclosure, the technical features in the above embodiments or different embodiments can also be combined, and the steps can be realized in any order; and there are many other changes in different aspects of one or more embodiments of this disclosure as described above, which are not provided in details for brevity.

[0051] One or more embodiment of this disclosure are intended to cover all such alternatives, modifications and variations that fall within that broad scope of the disclosure. Therefore, any omissions, modifications, equivalent substitutions, improvements, etc. made within the spirit and principles of one or more embodiments of this disclosure shall be encompassed within the protection scope of this disclosure.

CLAIMS

What is claimed is

1. An air-cooled noise-reducing stator core structure, comprising two end lamination modules and a middle lamination module, wherein each of the two end lamination modules comprises more than one end lamination (1), and all of end laminations (1) are each provided with a first air hole (11), and the middle lamination module comprises more than one first middle lamination (2) and more than one second middle lamination (3), and all of first middle laminations (2) are each provided with a second air hole (21) and a third air hole (22), the second air hole (21) is communicated with the third air hole (22), and all of second middle laminations (3) are each provided with a fourth air hole (31) and a fifth air hole (32), the fourth air hole (31) is separated from the third air hole (32); and

the middle lamination module is arranged between the two end lamination modules, and the first middle lamination (2) and the second middle lamination (3) are arranged to be overlapped between the two end lamination modules, the first air hole (11), the second air hole (21) and the fourth air hole (31) are communicated to form a main air duct (100), and the third air hole (22) and the fifth air hole (32) are communicated to form a branch air duct (200), and the branch air duct (200) is communicated with the main air duct (100) through a communication part of the second air hole (21) and the third air hole (22).

2. The air-cooled noise-reducing stator core structure according to claim 1, wherein an overlapping arrangement mode of the first middle lamination (2) and the second middle lamination (3) is as follows: there are more than two first middle laminations (2), all of the more than two first middle laminations (2) are divided into two groups, all of second middle laminations (3) are located between the two groups of first middle laminations (2), and two ends of the branch air duct (200) are each communicated with the main air duct (100) through the communication part of the second air hole (21) and the third air hole (22).

3. The air-cooled noise-reducing stator core structure according to claim 2, wherein the fifth air hole (32) includes n air sub-holes (321), wherein n is an odd number and greater than or equal to (3), and each of first middle laminations (2) is provided with a sixth air hole (23), the sixth air hole (23) is located at a side of the third air hole (22) and separated from the second air hole (21) and the third air hole (22), and a number of sixth air holes (23) on the first middle laminations (2) corresponding to the fifth air hole (32) is half of n-1; and

the third air holes (22) of one of the two groups of first middle laminations (2) is aligned and communicated with one of the air sub-holes (321), and the sixth air hole (23) is aligned and communicated with two adjacent air sub-holes (321), and the two groups of first middle laminations (2) are arranged in a mirror pattern, the n air sub-holes (321) of the fifth air hole (32) on of all of the second middle laminations (3) are communicated with each other through the sixth air hole (23) and communicated with the third air hole (22) to form a serpentine branch

air duct (200).

4. The air-cooled noise-reducing stator core structure according to claim 1, wherein an overlapping arrangement mode of the first middle lamination (2) and the second middle lamination (3) is as follows: there are more than two second middle laminations (3), all of the more than two second middle laminations (3) are divided into two groups, all of first middle laminations (2) are located between the two groups of second middle laminations (3), and the branch air duct (200) is cavity-shaped and is communicated with the main air duct (100) through one communication part of the second air hole (21) and the third air hole (22).

5. The air-cooled noise-reducing stator core structure according to claim 1, wherein an overlapping arrangement mode of the first middle lamination (2) and the second middle lamination (3) is as follows: all of first middle laminations (2) and all of second middle laminations (3) are respectively divided into two groups, the two groups of first middle laminations (2) and the two groups of second middle laminations (3) are arranged alternately, and the branch air duct (200) is cavity-shaped and is communicated with the main air duct (100) through more than two communication parts of the second air hole (21) and the third air hole (22).

6. The air-cooled noise-reducing stator core structure according to claim 1, wherein the third air hole (22) is located at a side of the second air hole (21) away from an axis of the first middle lamination (2), and the fifth air hole (32) is located at a side of the fourth air hole (31) away from an axis of the second middle lamination (3).

7. The air-cooled noise-reducing stator core structure according to claim 1, wherein the single middle lamination module and the two end lamination modules form a stator core subunit, and there are more than two stator core subunits which are axially arranged, and two adjacent stator core subunits share one end lamination module.

8. The air-cooled noise-reducing stator core structure according to claim 7, wherein overlapping arrangement modes of the first middle laminations (2) and the second middle laminations (3) in all of stator core subunits are same, or overlapping arrangement modes of the first middle laminations (2) and the second middle laminations (3) in at least two stator core subunits are different from each other.

9. The air-cooled noise-reducing stator core structure according to claim 1, wherein there are a plurality of first air holes 11, a plurality of second air holes (21), a plurality of third air holes (22), a plurality of fourth air holes (31) and a plurality of fifth air holes (32), the plurality of first air holes (11) are circumferentially arranged on the end lamination (1), the plurality of second air holes (21) and the plurality of third air holes (22) are circumferentially arranged on

the first middle lamination (2), and the plurality of fourth air holes (31) and the plurality of fifth air holes (32) are circumferentially arranged on the second middle lamination (3).

10. A traction electric motor, provided with the air-cooled noise-reducing stator core structure according to claim 1.