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											←— [illegible]层中心线 —→														槽底侧		←— a层中心线 —→											←— c层中心线 —→															
slot number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
c层	layer 1	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
	layer 2	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
b层	layer 3	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
	layer 4	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
	layer 5	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
	layer 6	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
a层	layer 7	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+
	layer 8	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+
																									槽口侧																														

Figure 4

(57) Abstract: A flat wire stator includes an outer stator iron core and a winding, wherein a plurality of slots are opening towards the inner circumference and a plurality of phase windings are arranged in the slots. Each phase winding consists of at least three parts, whereby a first part occupies the outermost layers of a slot and a third part the innermost winding layers of said slot. All three parts comprise the same pole pitch. Each part of each phase is positioned in at least three adjacent slots, such that a centre of each winding branch could be determined, wherein the centre of the first part is one slot apart from the centre of the second part and two slot apart from the centre of the third part. Further a driving motor comprising such a stator.

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FLAT WIRE STATOR AND DRIVE MOTOR COMPRISING SUCH A STATOR

Technical field

This application covers the technical field of drive motor, specifically a flat wire stator assembly and drive motor.

Background technology

As the national requirements for motor vehicle exhaust emissions become more stringent, especially in the automotive field, new energy vehicles will gradually replace the traditional internal combustion engine vehicles, and drive motors as the core drive components of new energy vehicles, Its performance will directly affect the comfort of the car, and the motor torque pulsation directly affect the user's ride experience, so improving the drive motor torque pulsation is important to improve the overall vehicle comfort.

Flat wire motor due to the advantages of high full groove rate, bottom end size, high thermal efficiency and other aspects, and more and more applied in the field of new energy vehicles, but the existing flat wire motor stator assembly is mostly a distance winding, It usually consists of stator cores, which have mounting slots open up the circumference of the stator core, and two mounting slots adjacent to them form stator teeth, which are wound on the stator core by stator teeth. In a distance winding structure, the equivalent pitch between the phase bands of the same phase winding at adjacent poles is equal to the pitch. However, the pitch winding structure can cause the drive motor to have a higher counter potential harmonic, which in turn results in a higher torque pulsation of the motor, which affects the overall vehicle comfort. At present, some manufacturers in order to reduce the torque pulsation of the motor, the stator winding of the motor is usually divided into two parts, and the center line of the two parts of the winding is staggered. This results in reduced torque pulsation. However, in actual use, it has been found that when using the above method, too many windings will make the torque pulsation optimization in the low speed zone less obvious.

A flat-wire stator assembly and drive motor are therefore urgently needed to optimize torque pulsation in both high and low speed zones.

summary of the invention

This request provides a flat-wire stator assembly and drive motor to address the problem of not optimizing torque pulsation in both high and low speed zones.

To address one or more of the above technical issues, the technical solutions used in this application are:

First, this application provides a flat wire stator assembly, including: Stator core and windings, the stator core opened with mounting through holes, the inner wall of the mounting through hole is provided with multiple slots in its own circumference, each of which extends in the direction of the axis of the stator core, parts of the winding are embedded in the mounting slots, parts of the winding are located outside the mounting slots, Each of the mounting slots has n layers of grooves set apart in the radial direction;

The winding in each phase shall consist of at least three parts, the first, second and third parts of which shall be distributed on n layers of the groove in the direction of the notch of the mounting groove pointing toward the bottom of the groove, the first part having a layer number of layers, the number of layers of the second part is b, the number of layers of the third part is c, where $a+b+c \leq n$ and n is the full number;

The centerline of the winding in Part I and Part III is distributed symmetrically with respect to the centerline of the winding in Part II, the centerline of the winding in Part I and Part III is misplaced with the centerline of the winding in Part II by the number of mounting slots equal to x.

Further, the centerline of the winding in Part I and in Part III is distributed symmetrically with respect to the centerline of the winding in Part II, and the centerline of the winding in Part I and in Part III is misplaced with the centerline of the winding in Part II by the number of mounting slots equal to x.

Further, $1 \leq x \leq 2$.

Further, n is even.

Further, a, b, and c are even numbers.

Further, when the winding in question is made up of three parts per phase, $a+b+c=n$.

Further, when n=8, a=2, b=4, c=2 or a=4, b=2, c=2 or a=2, b=2, c=4.

Further, the mounting slots described are rectangular slots.

Further, the number of slots of the mounting slots Q=2mpq, where p is the pole pair of the stator assembly and m is the number of phases of the stator assembly, q is the number of slots per phase per pole.

Further, Q=54, p=3, m=3.

Further, the winding has at least two phases, with insulation between adjacent two-layer winding structures belonging to different phases, in the same mounting slots.

Second, the application provides a drive motor, including: Rotor assembly, the rotor assembly is set in the space formed by the inner wall of the installation through hole.

Based on the specific embodiment provided in this application, the following technical effects are disclosed in this application:

By dividing the windings in the mounting slots into at least three sections, and at least one slot between the centerline of the windings of the first and third sections and the centerline of the windings of the second section, with the centerlines of the windings of the first and third sections on both sides of the centerline of the windings of the second section, that is, the distribution of the winding is changed by changing the centerline of the winding in different parts, This results in reduced harmonics of the winding counter-EMF to achieve optimum torque pulsation in both high and low speed zones.

Description of attached drawings

Figure 1 The structural diagram of the stator assembly provided for this application embodiment;

Figure 2 provides an overhead view of the stator assembly provided for the embodiment of this application;

Figure 3 shows an enlarged view of A in Figure 2;

Figure 4 An expanded diagram of the U phase windings provided for embodiment 1 of this application;

Figure 5 The expansion diagram of the three-phase winding provided for embodiment 1 of this application;

Figure 6 shows a comparison of the application embodiment with the low speed zone torque pulsation of the existing technology;

Figure 7 shows the high speed zone torque pulsation comparison between the embodiment of this application and the existing technology;

Figure 8 An expanded diagram of the U phase windings provided for embodiment 2 of this application;

Figure 9 The expansion diagram of the three-phase winding provided for embodiment 2 of this application;

Figure 10 An expanded diagram of the U phase windings provided for embodiment 3 of this application;

Figure 11 The three-phase winding expansion diagram provided for embodiment 3 of this application.

Mark with picture: 1, stator core; 11, mounting through hole; 12, mounting slot; 2, Windings.

Embodiments

Number of motor poles P, that is, the number of magnetic poles of the motor, magnetic poles are divided into N poles and S poles, generally a N pole and a S pole is called a pair of magnetic poles. That is, the logarithm p is 1, that is, P=2p; where the speed of the motor (n) and the logarithm (p) of the motor satisfy n=60f/p, where, f is the power frequency.

At present, according to the requirements of the speed, power performance and other aspects of new energy vehicles in the industry, the need to choose different speed drive motor, the general low speed motor speed is 3000 ~ 6000rpm, The speed of the medium speed motor is 6000 to 10000rpm, the speed of the high speed motor is more than 10000rpm.

The pole pitch refers to the range of each pole along the inner circle of the motor stator core, i.e. the span of the adjacent N and S poles relative to the groove. The pole pitch τ can be expressed as the number of slots per pole: T = Z/2p, where Z is the total number of slots on the stator core and p is the log pole.

The pitch is the distance crossed by the upper and lower edges of a coil and is expressed in y; for flat wire motors, the equivalent pitch is often used to describe the combined effect of the wide range of U-lines that form a winding, as there may be multiple spans. Even if the equivalent pitch is used as the pitch of the winding, the equivalent pitch is the distance between the first and second phase bands of the same phase winding at adjacent poles.

In addition, common winding methods for stator windings include full-distance windings, long-distance windings and short-distance windings, where The pitch winding is specified with the pitch equal to the pitch of the sub-winding, and the long pitch winding is specified with the pitch less than the pitch of the sub-winding.

When the motor is running, cutting the telecoil creates a counter-electric potential that is opposite to the voltage applied at both ends of the motor. The algebraic sum of the two coil edge potentials at the coil potential. The round winding has a 180° electric angle for the two coil edges, and the short winding has a less than 180° electric angle for the two coil edges. Therefore, the reverse eme potential of the pitch winding is higher, resulting in a higher harmonic of the reverse eme, resulting in a greater torque pulsation of the motor, which affects motor performance.

As mentioned in the background technology, the windings of the stator assembly are generally divided into two parts, one of which has an equivalent pitch set to a short distance to achieve the effect of reducing torque pulsation. However, the actual use of the stator assembly found that if the number of winding layers in the premise, continue to follow the "whole-short" setting, the torque pulsation optimization effect of the low speed zone of the drive motor is not good. It is not possible to balance optimum torque pulsation between high and low speed zones.

In order to solve one or more of the above technical problems in the existing technology, this application is creative proposed a flat-wire stator assembly and drive motor, by changing the distribution of windings to reduce the harmonics of the windings counter-emotive to achieve the effect of optimizing the torque pulsation in both the high and low speed regions.

The flat wire stator assembly of this application embodiment is described in detail below in conjunction with the attached diagram.

The stator assembly consists of stator core 1 and 3-phase winding, stator core 1 is cylindrical and stator core 1 is equipped with mounting through holes 11, as shown in Figure 1. The inner wall of the mounting through hole 11 has multiple slots 12 in its own circumference, either slot 12 extends along the axis of the stator core 1, the part of the winding 2 is embedded in the mounting slot 12, which acts as a stop fixing for the winding 2, The part of the winding 2 is located outside the mounting slots 12, each mounting slot 12 has n layers of grooves set in the radial direction, and specifically, $n \geq 8$.

Refer to Figure 2 and Figure 3, Figure 3 is the magnification of the A in Figure 2, the mounting slot 12 can be separated by n slots in its own radial direction according to the actual demand, in order to facilitate the winding and detection of the coil, Generally, the slot layer on the bottom side of the slot 12 is set to Layer1 and the slot side of the slot 12 is set to Layer n when n=8, as shown in Figure 3. Layer1 through Layer8 is distributed from the bottom side of the slot 12 to the slot side.

It is understood that the shape of the stator core 1 is cylindrical and is merely an illustrative and not a restrictive statement, and that any shape of stator core 1 may be used as stator core 1 in this application provided that it is not inconsistent with the idea of the invention of this application.

In the embodiment of this application, the pole pair p of the stator assembly is 3, the stator slot number Q is 54, and the slot number Q=2mpq of the stator slot, where q is the number of slots per phase per pole, and q is 3 per phase per pole by the formula above. Polar pitch $\tau = Z/2p = 9$.

In addition, in the embodiment of this application, the number of phases m of the stator assembly is 3 and the sight stator winding 2 includes the U phase winding. V phase windings, W phase windings. It is understood that the number of phases of a stator assembly of 3 is only an illustrative and not a restrictive statement, and that any phase number stator assembly may be used as a flat-wire stator assembly in this application provided that it is not inconsistent with the idea of the invention of the application.

Each phase winding consists of at least three parts, with the first, second and third parts distributed along the side of the mounting groove pointing toward the bottom of the groove, and the equivalent pitch of the first to third parts equal to the pole pitch. The centerlines of the windings of the first and third parts are located on both sides of the centerlines of the windings of the second part; the centerlines of the windings of the first and third parts are at least one slot apart from the centerlines of the windings of the second part 12.

Ideally, the centerline of the winding of the first and third parts is distributed symmetrically with respect to the centerline of the winding of the second part, and the centerline of the winding of the first and third parts is misaligned with the centerline of the winding of the second part with the number of slots equal to x, $1 \leq x \leq 2$.

Ideally, the centerline of the windings of both the first and third sections will be one slot 12 different from the centerline of the windings of the second section.

It is to be noted that the round winding refers to the equivalent pitch between the bands of the same winding at adjacent poles equal to the pitch. If the number of slots per phase is q per pole is 3, the centerline of the middle groove in the three consecutive stator slots occupied by the same phase winding at that pole is the centerline of the winding.

Set the number of slices in the first part to a slice, the number of slices in the second part to b slices, and the number of slices in the third part to c slices, where $a+b+c \leq n$.

Where a can be even, b can be even, c can be even, When one winding coil is wound on the corresponding mounting slot 12, it occupies two layers, and when at least one of a, b and c is odd, Will make the end of the wire leg of the adjacent winding coil when welding, the weld end torsion direction is not consistent, leading to problems such as torsion and welding complexity, making the design of the winding structure more complex. More difficult to achieve.

If a, b and c are even, this allows the multiple winding coils to be set in the same way on the mounting slots 12, so that the angle of the torsion head of winding 2 at the welded end is consistent. In turn, the weld end torsion orientation is not consistent, resulting in torsion and welding complexity and other issues, further effectively simplify the design of winding 2, facilitate the construction.

The winding spread diagram is usually used to show the distribution of the winding coils in stator slots 11, with the row heading slot number and the column heading Layer, and the bottom and slot sides are usually filled in the first and last rows of the diagram, respectively. to distinguish the direction in which the layer numbers are arranged, and to separate Layers by adding the layer numbers to the side of the column heading, Layer1 and Layer2 are part of the same layer if the a layer includes Layer1 and Layer2. Each specific cell is filled in with a number plus a plus or minus sign, for example U+ or U-, where "+" indicates that the current flows into the winding, and "-" indicates that the current flows out of the winding.
Ideally, in the embodiment of this application, each phase winding consists of three parts, n = 8.

Example 1

Set a to 2, b to 4, and c to 2.

Referring to Figure 4, Figure 4 shows the U-phase windings of the 6-pole 54-slot, corresponding to the first part from the slot side to the bottom of the slot. Part II, Part III, i.e., layer a, layer b, c-layer, corresponding to, a layer consists of Layer7, Layer8, Layer b consists of Layer3 (Layer 3) to Layer6 (Layer 6), and layer c consists of Layer1 (Layer 1), Layer2 (Layer 2), numbered sequentially from 1 to 54 for the 54 mounting slots 12 of Core 1. "U+" indicates that current flows into the U-phase windings and "U-" indicates that current flows out of the U-phase windings.

As shown in Figure 4, there are nine mounting slots for each of the adjacent U+ and U- parts a, b, c, and so on. means a, b, c, that is, part I, part II, The equivalent pitch of the third part is 9 = τ, meaning that the first part, the second part and the third part are all round-distance windings. The centerline of the winding of the first part differs from the centerline of the winding of the second part by one slot 12, the centerline of the winding of the third part differs from the centerline of the winding of the first part by one slot 12, and the centerlines of the winding of the first and third parts are located on both sides of the centerline of the winding of the second part, specific, The centerline of the winding in the first part is to the left of the centerline of the winding in the second part and the centerline of the winding in the third part is to the right of the centerline of the winding in the second part, i.e. the centerline of the winding in the first part is two slots 12 apart from the centerline of the winding in the third part.

By way of illustration, the part of the a-layer is routed as follows: Slot 17, Slot 7 to Slot 26, Layer 8, Slot 18, Slot 7 to Slot 27, Layer 8, Slot 19, Layer 7 to Slot 28, Layer 8. The part of the b is routed as follows: Slot 18 Layer 3 to Slot 27 Layer 4, Slot 19 Layer 3 to Slot 28 Layer 4, Slot 20 Layer 3 to Slot 29 Layer 4, Slot 18 Layer 5 to Slot 27 Layer 6, Slot 19 Layer 5 to Slot 28 Layer 6, Slot 20 Layer 5 to Slot 29 Slot Level 6. The part of the c-tier is routed as follows: Slot 19, Slot 1 to Slot 28, Layer 2, Slot 20, Slot 1 to Slot 29, Layer 2, Slot 21, Slot 1 to Slot 30, Layer 2.

Figure 5 is an expanded diagram of the three-phase winding for embodiment 1, corresponding to the first and second parts of the three-phase winding from the slot side to the bottom side of the groove, respectively. The third part, the a, b, c, in the diagram, Accordingly, the a layer consists of Layer7, Layer8, and the b layer consists of Layer3 through Layer6. The c-layer consists of Layer1 (Layer 1), Layer2 (Layer 2), 54 stator slots 11 of the stator core 1 are numbered sequentially from 1 to 54, and "U+" indicates that current flows into the U phase windings. "U-" indicates current flow out of the U-phase winding, "V+" indicates current flow into the V-phase winding, "V-" indicates current flow out of the V-phase winding, "W+" indicates current flow into the W-phase winding, "W-" indicates that the current flows out of the W-phase windings.

As shown in Figure 5, the V+ and V- adjacent to layers a, b, and c are each separated by nine mounting slots, and layers a, There are 9 slots between the W+ and W- adjacent to the b and c layers, indicating that the equivalent pitch for the a, b and c layers is 9 = τ, that is, the first part. The equivalent pitch for Part Two and Part Three is 9 = τ.

For example, the V-phase portion of the a-slice is routed as follows: Slot 20, Slot 7 to Slot 29, Layer 8, Slot 21, Slot 7 to Slot 30, Layer 8, Slot 22, Layer 7 to Slot 31, Layer 8. The W-phase of the a-layer is routed as follows: Slot 23, Slot 7 to Slot 32, Layer 8, Slot 24, Slot 7 to Slot 33, Layer 8, Slot 25, Slot 7 to Slot 34, Layer 8. The V-phase portion of the b-slice is routed as follows: Slot 21, Slot 3 to Slot 30, Layer 4, Slot 22, Slot 3 to 31, Layer 4, Slot 23, Slot 3 to Slot 32, Layer 4; Slot 21, Slot 5 to Slot 30, Layer 6, Slot 22, Slot 5 to 31, Layer 6, Slot 23, Slot 5 to Slot 31 Level 6. Part of the B-phase is routed as follows: Slot 24 Layer 3 to Slot 33 Layer 4, Slot 25 Layer 3 to Slot 34 Layer 4, Slot 26 Layer 3 to Slot 35 Layer 4; Slot 24 Layer 5 to Slot 33 Layer 6, Slot 25 Layer 5 to Slot 34 Layer 6, Slot 26 Layer 5 to 3 Slot 5 Tier 6. The V-phase portion of the c-slice is routed as follows: Slot 22 Tier 1 to Slot 31 Tier 2, Slot 23 Tier 1 to Slot 32 Tier 2, Slot 24 Tier 1 to Slot 33 Tier 2. The part of the c-layer W phase is routed as follows: Slot 25, Slot 1 to Slot 34, Layer 2, Slot 26, Slot 1 to Slot 35, Layer 2, Slot 27, Slot 1 to Slot 36, Layer 2.

In combination with the three-phase winding as shown in Figure 5, all three parts of this embodiment are of a well-spaced winding structure, and the distribution of winding 2 is altered by diverting the centerline of the winding in the first and third parts from the centerline of the winding in the second part. This in turn reduces the harmonics of the windings 2 counter-EMF to optimize the torque pulsation.

For ease of comparison, highlight the torque pulsation optimization effect of this embodiment and set a pair of proportions to compare. The parameters for the scale are basically the same as in embodiment 1, with the following different parameters: The centerlines of all winding layers are collinear, i.e. the equivalent pitch for the proportional winding is an integer pitch. Figure 6 is a low-speed torque pulsation comparison graph, Figure 7 is a high-speed torque pulsation comparison graph, and the longitudinal parameter of Figures 6 and 7 is the percentage reduction in torque pulsation, specifically, IMPLEMENT EXAMPLE 1 In comparison to the ratio, IMPLEMENTATION 1 of this application has approximately 1% lower torque pulsation in the low speed zone than the existing technology and approximately 17.5% lower torque pulsation in the high speed zone. This embodiment 1 can be seen to combine torque pulsation optimization in both high and low speed zones.

Example 2

Set a to 4, b to 2, c to 2.

Referring to Figure 8, Figure 8 is a 6-pole, 54-slot, U-phase windings flattened out, corresponding to the first part from the slot side to the bottom of the slot. Part II, Part III, i.e., layer a, layer b, the c-layer, corresponding to, the a layer consists of Layer5 (Layer 5) through Layer8 (Layer 8) and the b layer consists of Layer3 (Layer 3). Layer4, layer c consists of Layer1, Layer2, the 54 mounting slots 12 of the iron core 1 are numbered from 1 to 54, "U+" indicates that current flows into the U-phase windings and "U-" indicates that current flows out of the U-phase windings.

As shown in Figure 8, there are 9 slots between the adjacent U+ and U- in parts a, b, c. means a, b, c, that is, part I, part II, The equivalent pitch of the third part is 9 = τ, meaning that the first part, the second part and the third part are all round-distance windings. The centerline of the winding of the first and third parts is one slot 12 different from the centerline of the winding of the second part, and the centerlines of the winding of the first and third parts are symmetrically distributed in relation to the centerline of the winding of the second part, specifically, the centerline of the winding of the first part is located to the left of the centerline of the winding of the second part. The centerline of the winding of the third part is located to the right of the centerline of the winding of the second part, i.e. the centerline of the winding of the first part is two slots 12 apart from the centerline of the winding of the third part.

Instinctively, The part of the layer is routed as follows: Slot 17 Tier 5 to 26 Tier 6, Slot 18 Tier 5 to 27 Tier 6, Slot 19 Tier 5 to 28 Tier 6; Slot 17 Tier 7 to 26 Tier 8, Slot 18 Tier 7 to 27 Tier 8, Slot 19 Tier 7 to 28 Slot Level 8. Part of the b is routed as follows: Slot 18, Slot 3 to Slot 27, Layer 4, Slot 19, Slot 3 to Slot 28, Layer 4, Slot 20, Slot 3 to Slot 29, Layer 4. The part of the c-tier is routed as follows: Slot 19, Slot 1 to Slot 28, Layer 2, Slot 20, Slot 1 to Slot 29, Layer 2, Slot 21, Slot 1 to Slot 30, Layer 2.

Figure 9 is an expanded diagram of the three-phase winding for embodiment 2, corresponding to the first and second parts of the three-phase winding from the slot side to the bottom side of the groove, respectively. The third part, the a, b, c, in the diagram, Accordingly, the a layer consists of Layer5 (Layer 5) through Layer8 (Layer 8), and the b layer consists of Layer3 (Layer 3), Layer4 (Layer 4). The c-layer consists of Layer1 (Layer 1), Layer2 (Layer 2), 54 stator slots 11 of the stator core 1 are numbered sequentially from 1 to 54, and "U+" indicates that current flows into the U phase windings. "U-" indicates current flow out of the U-phase winding, "V+" indicates current flow into the V-phase winding, "V-" indicates current flow out of the V-phase winding, "W+" indicates current flow into the W-phase winding, "W-" indicates that the current flows out of the W-phase windings.

As shown in Figure 9, the V+ and V- adjacent to layers a, b, and c are all different by nine mounting slots, and layers a, There are 9 slots between the W+ and W- adjacent to the b and c layers, indicating that the equivalent pitch for the a, b and c layers is 9 = τ, that is, the first part. The equivalent pitch for Part Two and Part Three is 9 = τ.

Instinctively, The V-phase portion of the a-layer is routed as follows: slot 20 layer 5 to 29 layer 6, slot 21 layer 5 to 30 layer 6, slot 22 layer 5 to 31 layer 6; slot 20 layer 7 to 29 layer 8, slot 21 layer 7 to 30 layer 8, slot 22 layer 7 to Slot 31 Tier 8. The part of the W-phase of the a-layer is routed as follows: Slot 23 Tier 5 to Slot 32 Tier 6, Slot 24 Tier 5 to Slot 33 Tier 6, Slot 25 Tier 5 to Slot 34 Tier 6; Slot 23 Tier 7 to Slot 32 Tier 8, Slot 24 Tier 7 to Slot 33 Tier 8, Slot 25 Tier 7 to Slot 34 Level 8. The V-phase portion of the b-slice is routed as follows: Slot 21, Slot 3 to Slot 30, Layer 4, Slot 22, Slot 3 to Slot 31, Layer 4, Slot 23, Slot 3 to Slot 32, Layer 4. Part of the B-layer W phase is routed as follows: Slot 24 Level 3 to Slot 33 Level 4, Slot 25 Level 3 to Slot 34 Level 4, Slot 26 Level 3 to Slot 35 Level 4. The V-phase portion of the c-slice is routed as follows: Slot 22 Tier 1 to Slot 31 Tier 2, Slot 23 Tier 1 to Slot 32 Tier 2, Slot 24 Tier 1 to Slot 33 Tier 2. The part of the c-layer W phase is routed as follows: Slot 25, Slot 1 to Slot 34, Layer 2, Slot 26, Slot 1 to Slot 35, Layer 2, Slot 27, Slot 1 to Slot 36, Layer 2.

In combination with the three-phase winding as shown in Figure 9, the three parts of this embodiment are of a well-spaced winding structure, and the distribution of the winding 2 is changed by diverting the centerline of the winding in the first and third parts from the centerline of the winding in the second part. This in turn reduces the harmonics of the windings 2 counter-EMF to optimize the torque pulsation.

Implementation Example 3

Set a to 2, b to 2, c to 4.

Referring to Figure 10, Figure 10 shows the U-phase winding of the 6-pole 54-slot, corresponding to the first part from the slot side to the bottom side of the slot. Part II, Part III, i.e., layer a, layer b, c-layer, corresponding to, a layer consists of Layer7, Layer8, Layer b consists of Layer5 (Layer 5), Layer 6 (Layer 6), and layer c consists of Layer1 (Layer 1) through Layer4 (Layer 4), numbered sequentially from 1 to 54 for 54 mounting slots 12 of Core 1. "U+" indicates that current flows into the U-phase windings and "U-" indicates that current flows out of the U-phase windings.

As shown in Figure 10, there are nine mounting slots for each of the adjacent "U+" and "U-" parts a, b, c. means a, b, c, that is, part I, part II, The equivalent pitch of the third part is 9 = τ, meaning that the first part, the second part and the third part are all round-distance windings. The centerline of the winding of the first part differs from the centerline of the winding of the second part by one slot 12, the centerline of the winding of the third part differs from the centerline of the winding of the first part by one slot 12, and the centerlines of the winding of the first and third parts are located on both sides of the centerline of the winding of the second part, specific, The centerline of the winding in the first part is to the left of the centerline of the winding in the second part and the centerline of the winding in the third part is to the right of the centerline of the winding in the second part, i.e. the centerline of the winding in the first part is two slots 12 apart from the centerline of the winding in the third part.

By way of illustration, the part of the a-layer is routed as follows: Slot 17, Slot 7 to Slot 26, Layer 8, Slot 18, Slot 7 to Slot 27, Layer 8, Slot 19, Layer 7 to Slot 28, Layer 8. Part of the b is routed as follows: Slot 18, Slot 5 to Slot 27, Slot 19, Slot 5 to Slot 28, Layer 6, Slot 20, Slot 5 to Slot 29, Layer 6. The part of the c-tier is routed as follows: Slot 19 Tier 1 to Slot 28 Tier 2, Slot 20 Tier 1 to 29 Tier 2, Slot 21 Tier 1 to Slot 30 Tier 2; Slot 19 Tier 3 to Slot 28 Tier 4, Slot 20 Tier 3 to Slot 29 Tier 4, Slot 21 Tier 3 to 30 Slot Layer 4.

Figure 11 is an expanded diagram of the three-phase winding for embodiment 3, corresponding to the first and second parts of the three-phase winding from the slot side to the bottom side of the groove, respectively. The third part, the a, b, c, in the diagram, Accordingly, layer a includes Layer7 (Layer 7), layer 8 (Layer 8), and layer b includes Layer5 (Layer 5). Layer6 (layer 6), the c-layer consists of Layer1 (layer 1) to Layer4 (layer 4), the 54 stator slots 11 of the stator core 1 are numbered sequentially from 1 to 54, "U+" indicates that current flows into the U phase windings, "U-" indicates current flow out of the U-phase winding, "V+" indicates current flow into the V-phase winding, "V-" indicates current flow out of the V-phase winding, "W+" indicates current flow into the W-phase winding, "W-" indicates that the current flows out of the W-phase windings.

As shown in Figure 11, the V+ and V- adjacent to layers a, b, and c are all different by nine slots, and layers a, There are 9 slots between the W+ and W- adjacent to the b and c layers, indicating that the equivalent pitch for the a, b and c layers is 9 = τ, that is, the first part. The equivalent pitch for Part Two and Part Three is 9 = τ.

For example, the V-phase portion of the a-slice is routed as follows: Slot 20, Slot 7 to Slot 29, Layer 8, Slot 21, Slot 7 to Slot 30, Layer 8, Slot 22, Layer 7 to Slot 31, Layer 8. The W-phase of the a-layer is routed as follows: Slot 23, Slot 7 to Slot 32, Layer 8, Slot 24, Slot 7 to Slot 33, Layer 8, Slot 25, Slot 7 to Slot 34, Layer 8. The V-phase portion of the b-slice is routed as follows: Slot 21, Slot 5 to Slot 30, Layer 6, Slot 22, Slot 5 to Slot 31, Layer 6, Slot 23, Slot 5 to Slot 31, Layer 6. Part of the B-layer W phase is routed as follows: Slot 24 Tier 5 to Slot 33 Tier 6, Slot 25 Tier 5 to Slot 34 Tier 6, Slot 26 Tier 5 to Slot 35 Tier 6. The V-phase portion of the c-slice is routed as follows: Slot 22 Tier 1 to Slot 31 Tier 2, Slot 23 Tier 1 to Slot 32 Tier 2, Slot 24 Tier 1 to Slot 33 Tier 2; Slot 22 Tier 3 to Slot 31 Tier 4, Slot 23 Tier 3 to Slot 32 Tier 4, Slot 24 Tier 3 to Slot 33 4. The part of the c-layer W phase is routed as follows: Slot 25, Slot 1 to Slot 34, Layer 2, Slot 26, Slot 1 to Slot 35, Layer 2, Slot 27, Slot 1 to Slot 36, Layer 2.

In combination with the three-phase winding as shown in Figure 11, all three parts of this embodiment are of a well-spaced winding structure, and the distribution of winding 2 is altered by diverting the centerline of the winding in the first and third parts from the centerline of the winding in the second part. This in turn reduces the harmonics of the windings 2 counter-EMF to optimize the torque pulsation.

The embodiment of this application also provides a drive motor, which can be a permanent magnet synchronous motor, an AC asynchronous motor, etc. The drive motor consists of the rotor assembly and the stator assembly of the embodiment of this application, which is located in a space formed around the inner wall of the installation through hole 11.

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Claims

1. A flat wire stator component, characterized in that the stator component comprises a stator core and a winding, wherein the stator core is provided with an installation through hole, and the inner wall of the installation through hole is provided with multiple installation slots along its own circumference. Any installation slot extends along the axis direction of the stator core, and a part of the winding is embedded in the installation slot, while a part of the winding is located outside the installation slot, each installation slot has n slot layers spaced in a radial direction;

Each phase of the winding comprises at least three parts, with a first part, a second part, and a third part distributed sequentially along the direction of the slot of the installation slot pointing towards the bottom of the slot on n slot layers. The first part has a layer of a, the second part has a layer of b, and the third part has a layer of c, where $a+b+c \leq n$, and n is a positive integer;

The equivalent pitch of the first part to the third part is equal to the pole pitch, and the winding centerlines of the first part and the third part are located on both sides of the winding centerline of the second part, respectively; The winding centerline of the first and third parts is at least one installation slot away from the winding centerline of the second part.

2. The flat wire stator component according to claim 1, characterized in that the winding centerline of the first and third parts is symmetrically distributed about the winding centerline of the second part, and the number of installation slots where the winding centerline of the first and third parts is misaligned with the winding centerline of the second part is equal to x.

3. The flat wire stator component according to claim 2, characterized in that $1 \leq x \leq 2$.

4. The flat wire stator component according to claim 1, characterized in that n is an even number.

5. The flat wire stator component according to claim 4, characterized in that a, b, and c are all even

numbers.

6. The flat wire stator component according to claim 1, characterized in that when each phase of the
winding is composed of three parts, a+b+c=n.

7. The flat wire stator component according to claim 6, characterized in that when n=8, a=2, b=4, c=2 or a=4, b=2, c=2 or a=2, b=2, c=4.

8. The flat wire stator component according to claim 1, characterized in that the installation slot is a rectangular slot.

9. The flat wire stator component according to claim 1, characterized in that the number of slots in the installation slot Q=2mpq, where p is the number of pole pairs of the stator component, m is the number of phases of the stator component, and q is the number of slots per pole per phase.

10. The flat wire stator component according to claim 9, characterized in that Q=54, p=3, m=3.

11. The flat wire stator component according to claim 1, characterized in that the winding has at least two phases, and insulating elements are arranged between adjacent two winding structures belonging to different phases within the same installation slot.

12. A drive motor comprising any of the flat wire stator components claimed in claims 1-11, characterized in that the drive motor comprises a rotor component located in a space enclosed by the inner wall of the mounting through hole.

*****

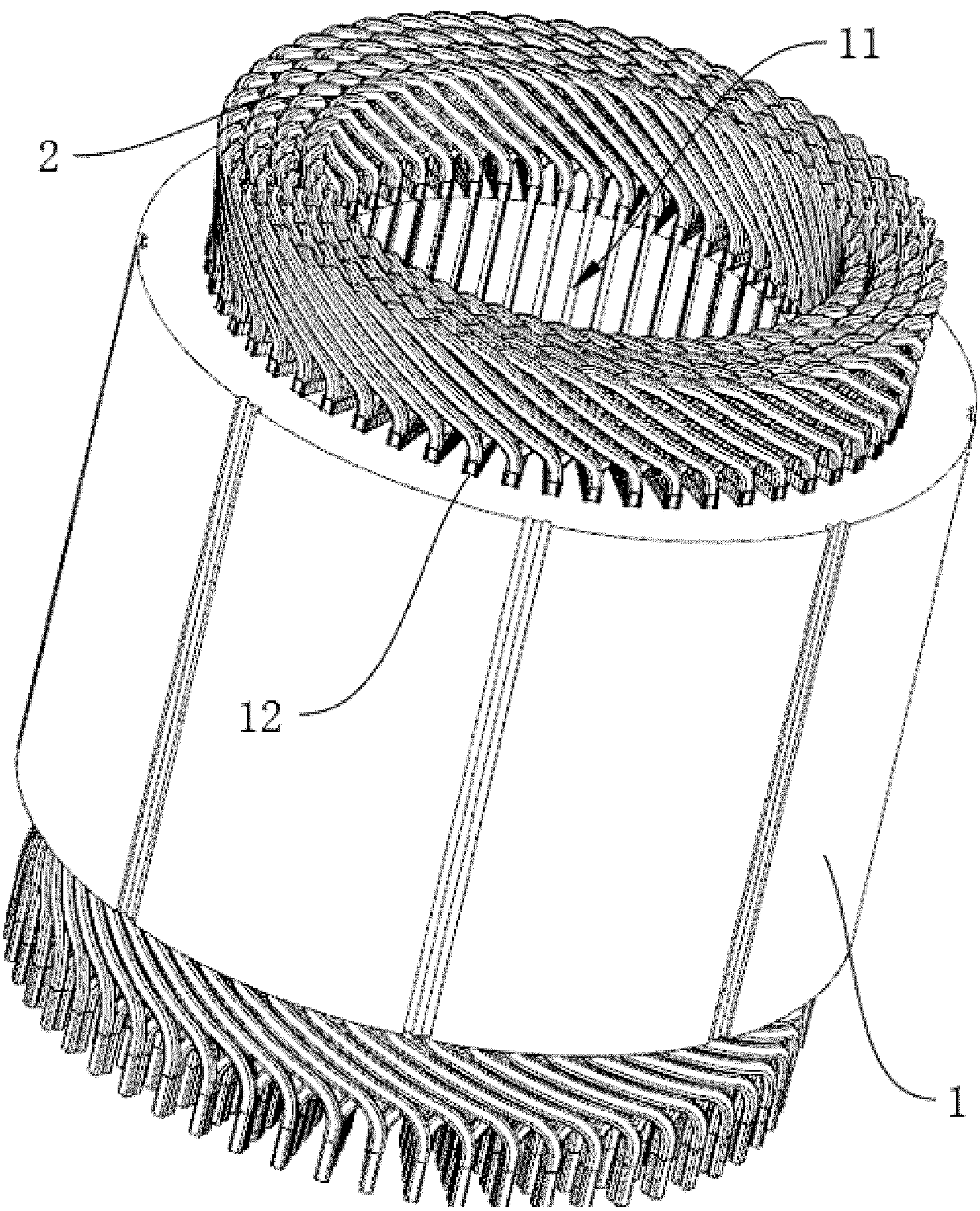

Figure 1

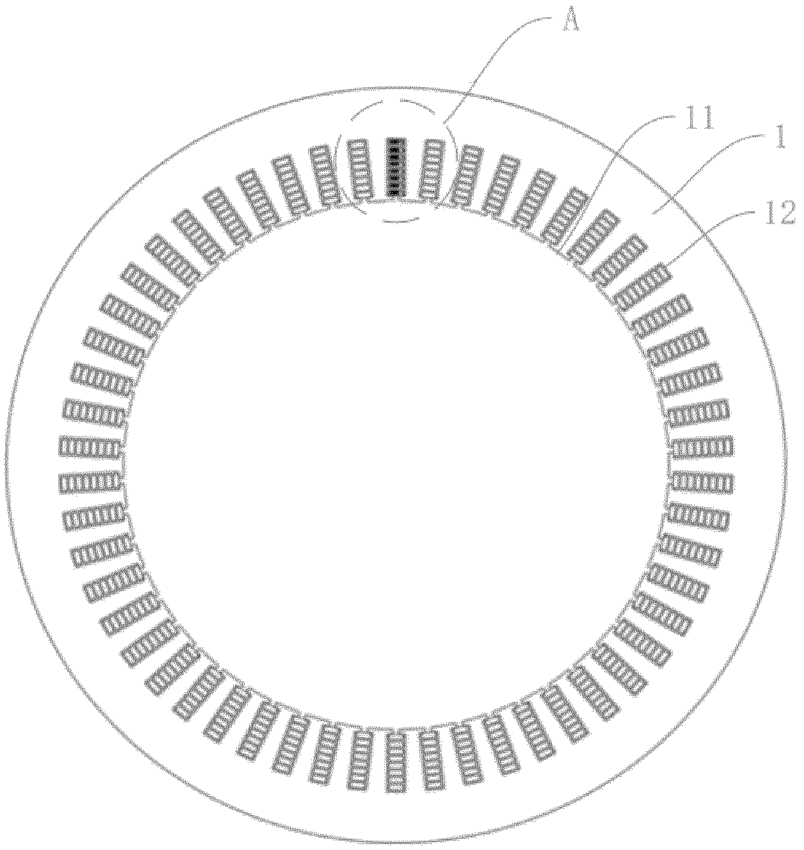

Figure 2

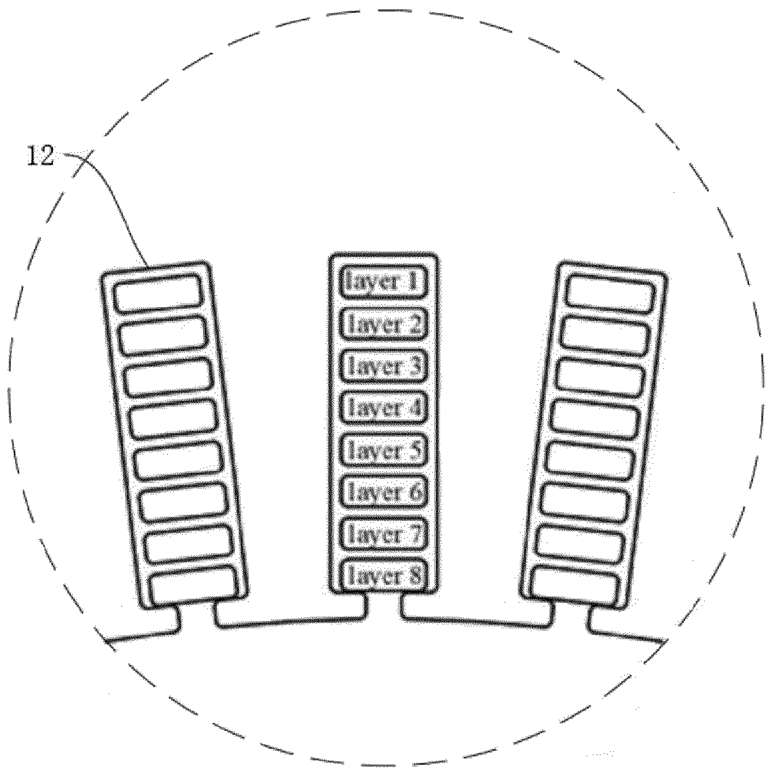

Figure 3

														b层中心线					
slot number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
c层	layer 1	U+	U+	U+							U-	U-	U-						
	layer 2	U+	U+	U+							U-	U-	U-						
b层	layer 3	U+	U+							U-	U-	U-							U+
	layer 4	U+	U+							U-	U-	U-							U+
	layer 5	U+	U+							U-	U-	U-							U+
	layer 6	U+	U+							U-	U-	U-							U+
a层	layer 7	U+							U-	U-	U-							U+	U+
	layer 8	U+							U-	U-	U-							U+	U+

								槽底侧						a层中心线					
slot number		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
c层	layer 1	U+	U+	U+							U-	U-	U-						
	layer 2	U+	U+	U+							U-	U-	U-						
b层	layer 3	U+	U+							U-	U-	U-							U+
	layer 4	U+	U+							U-	U-	U-							U+
	layer 5	U+	U+							U-	U-	U-							U+
	layer 6	U+	U+							U-	U-	U-							U+
a层	layer 7	U+							U-	U-	U-							U+	U+
	layer 8	U+							U-	U-	U-							U+	U+
								槽口侧											

							c层中心线												
slot number		37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
c层	layer 1	U+	U+	U+							U-	U-	U-						
	layer 2	U+	U+	U+							U-	U-	U-						
b层	layer 3	U+	U+							U-	U-	U-							U+
	layer 4	U+	U+							U-	U-	U-							U+
	layer 5	U+	U+							U-	U-	U-							U+
	layer 6	U+	U+							U-	U-	U-							U+
a层	layer 7	U+							U-	U-	U-							U+	U+
	layer 8	U+							U-	U-	U-							U+	U+

Figure 4

槽底侧

slot number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
c层	Layer 1	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+
	Layer 2	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+
b层	Layer 3	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-
	Layer 4	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-
	Layer 5	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-
	Layer 6	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-
a层	Layer 7	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-
	Layer 8	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-

slot number		28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
c层	Layer 1	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-
	Layer 2	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-
b层	Layer 3	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
	Layer 4	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
	Layer 5	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
	Layer 6	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
a层	Layer 7	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
	Layer 8	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+

槽口侧

Figure 5

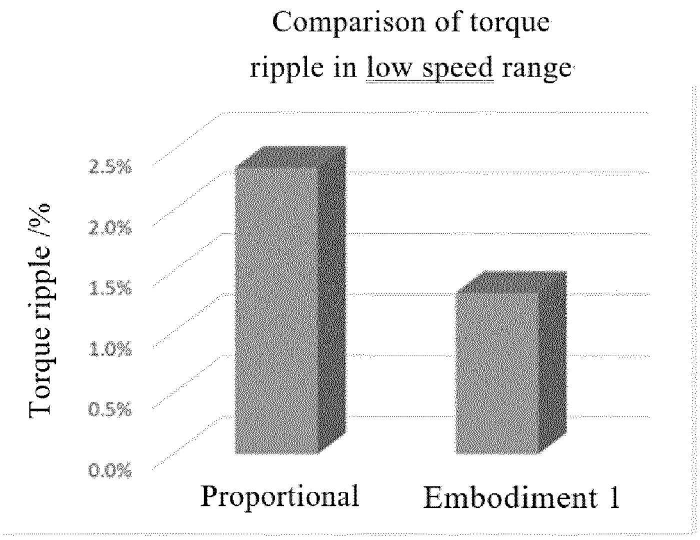

Figure 6

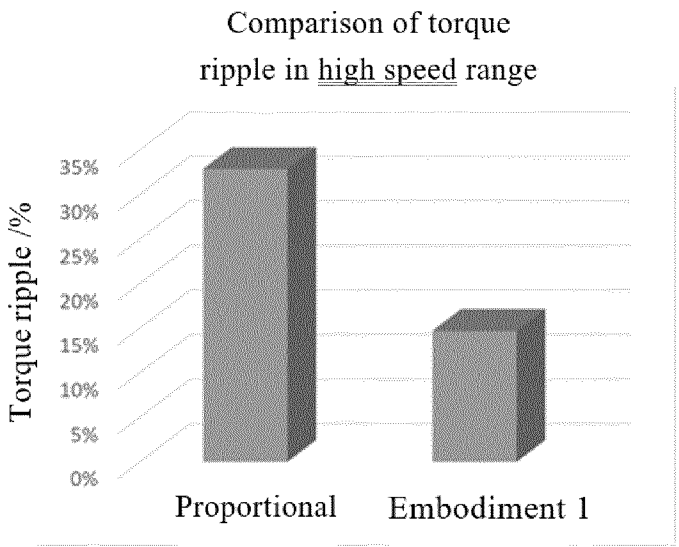

Figure 7

槽底侧																																																							
slot number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
c层	layer 1	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
	layer 2	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
b层	layer 3	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
	layer 4	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
a层	layer 5	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+
	layer 6	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+
	layer 7	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+
	layer 8	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+
槽口侧																																																							

Figure 8

槽底侧

slot number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
c层	layer 1	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-
	layer 2	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-
b层	layer 3	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
	layer 4	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
a层	layer 5	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
	layer 6	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
	layer 7	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
	layer 8	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+

槽口侧

Figure 9

槽底侧

slot number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
c层	layer 1	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
	layer 2	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
	layer 3	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
	layer 4	U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-						
b层	layer 5	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
	layer 6	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+
a层	layer 7	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+
	layer 8	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+	U+							U-	U-	U-							U+	U+

槽口侧

Figure 10

槽底侧																																																							
slot number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
c层	layer 1	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-
	layer 2	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-
b层	layer 3	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
	layer 4	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+
a层	layer 5	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
	layer 6	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
	layer 7	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
	layer 8	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+	U+	V-	V-	V-	W+	W+	W+	U-	U-	U-	V+	V+	V+	W-	W-	W-	U+	U+
槽口侧																																																							

Figure 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/062785

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02K29/03 H02K3/28 H02K3/12
ADD. H02K1/16

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)
H02K

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)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 August 2024	21/08/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	von Rauch, Marianne

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International application No
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