(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 March 2015 (26.03.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/040468 A1

(51) International Patent Classification:
H02K 3/34 (2006.01) *H02K 11/00* (2006.01)
H02K 3/50 (2006.01)

(21) International Application Number:
PCT/IB2014/001851

(22) International Filing Date:
17 September 2014 (17.09.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2013-195185 20 September 2013 (20.09.2013) JP

(71) Applicant: **TOYOTA JIDOSHA KABUSHIKI KAISHA** [JP/JP]; 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP).

(72) Inventor: **KITADA, Daisuke**; c/o Toyota Jidosha Kabushiki Kaisha, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

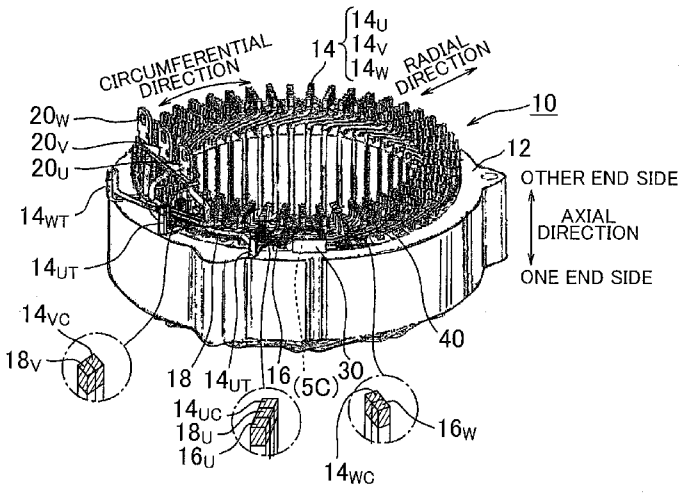
Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: STATOR FOR ROTARY ELECTRIC MACHINE

FIG. 1



(57) Abstract: A stator for a rotary electric machine includes a stator core, phase coils, a neutral line, a temperature sensor, and a cuff support. The phase coils wound around the stator core. The neutral line connects together one side end portion of each of the phase coil. The temperature sensor is provided on the neutral line, and is arranged with a space between the temperature sensor and an end surface of the stator core. The cuff support is arranged fixed to the end surface of the stator core. The cuff support is made of an insulator. The cuff support and the temperature sensor are fixed by an adhesive.

WO 2015/040468 A1

STATOR FOR ROTARY ELECTRIC MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a stator for a rotary electric machine. More particularly, the invention relates to a stator in which a temperature sensor is provided on a neutral line of a stator winding.

2. Description of Related Art

[0002] When a rotary electric machine operates, the temperature of a winding wound around a stator rises, so a temperature sensor is provided in order to detect this rise in temperature. The temperature sensor may be provided on a neutral line of the stator winding.

[0003] Japanese Patent Application Publication No. 2013-121183 (JP 2013-121183 A) describes a structure in which a temperature sensor provided on a neutral line of a stator winding of a rotary electric machine is able to be easily replaced when it fails. In the described structure, a tip end portion of the winding that is connected to the neutral line is made longer in the axial direction of the stator than connecting portions of the other windings, so the connection between the tip end portion of the winding and the neutral line is able to be undone easily. Also, the tip end portion of the winding that is connected to the neutral line is able to be easily disconnected even when is extended toward the outer peripheral side in the radial direction of the stator.

[0004] As art related to the invention, Japanese Patent Application Publication No. 2006-223058 (JP 2006-223058 A) describes a stator structure in which, in order to make up for insufficient rigidity of insulating paper that is inserted into a slot, a jig that is referred to as a cuff support that matches the shape of the slot is inserted after the insulating paper is inserted into the slot, but before the coil is wound. This is done to prevent the coil from contacting an end surface of a stator core and becoming damaged, which may occur if the

coil becomes twisted with strong force in the direction of the end surface of the stator core when the coil is wound in the slot, because the insulating paper has no rigidity.

SUMMARY OF THE INVENTION

[0005] The neutral line of the stator winding connects the neutral line side end portion of each phase winding together by welding or the like, so the portion between welding connection points is like a cantilever and is not fixed. If a temperature sensor is provided on an unfixed neutral line, the temperature sensor is also unable to be stably fixed. For example, if external vibration or the like is received in this state, the neutral line may vibrate easily depending on the mass of the temperature sensor, and in some cases, sufficient vibration resistance strength may be unable to be ensured.

[0006] The invention thus provides a stator for a rotary electric machine capable of stably fixing a temperature sensor.

[0007] One aspect of the invention relates to a stator for a rotary electric machine includes a stator core, phase coils, a neutral line, a temperature sensor, and a cuff support. The phase coils wound around the stator core. The neutral line connects together one side end portion of each of the phase coil. The temperature sensor is provided on the neutral line, and is arranged with a space between the temperature sensor and an end surface of the stator core. The cuff support is arranged fixed to the end surface of the stator core. The cuff support is made of an insulator. The cuff support and the temperature sensor are fixed by an adhesive.

[0008] In the stator according to the one aspect of the invention, the temperature sensor and the phase coil may be fixed together by the adhesive.

[0009] In the stator according to the one aspect of the invention, the temperature sensor and the end surface of the stator core may be fixed together by the adhesive.

[0010] In the stator according to the one aspect of the invention, the adhesive may accumulate in a portion defined by an upper surface of the cuff support and a side wall surface of the temperature sensor.

[0011] In the stator according to the one aspect of the invention, a portion of the

temperature sensor may be covered by the adhesive.

[0012] In the stator according to the one aspect of the invention, an upper surface of the cuff support may be a positioning reference when connecting a neutral point side end portion of the phase coil to an end portion of the neutral line.

[0013] With the stator according to the one aspect of the invention, the temperature sensor is fixed to the cuff support by the adhesive, so the temperature sensor is able to be stably fixed. Also, as a result, the vibration resistance strength of the neutral line on which the temperature sensor is provided improves.

[0014] Also, in the stator, the temperature sensor and the stator coil are fixed to each other by the adhesive, so the temperature sensor is able to be stably fixed.

[0015] Also, in the stator, the temperature sensor and the end surface of the stator core are fixed to each other by the adhesive, so the temperature sensor is able to be stably fixed.

[0016] Also, in the stator, the adhesive accumulates in a portion defined by the upper surface of the cuff support and the side wall surface of the temperature sensor, so the adhesive is inhibited from flowing to the outer peripheral side of the stator, and the temperature sensor is able to be stably fixed.

[0017] Also, in the stator, at least a portion of the temperature sensor is covered by the adhesive, so the temperature sensor is inhibited from being directly exposed to coolant for cooling the stator, or the like. As a result, detection error by the temperature sensor due to coolant is able to be inhibited.

[0018] Also, in the stator, the upper surface position of the cuff support serves as the height positioning reference when connecting the neutral line side end portion of the stator coil to the end portion of the neutral line, so the connection of the neutral line is able to be stably performed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the

accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a block diagram of a rotary electric stator according to the invention;

FIG. 2 is a connection wiring diagram of various phase coils of the rotary electric machine stator according to the invention;

FIG. 3 is a view illustrating the relationship between a cuff support, a temperature sensor, and an adhesive portion, in the rotary electric machine stator according to the invention;

FIG. 4A is an exploded block diagram of the rotary electric machine stator according to the invention, which shows a stator core and slots;

FIG. 4B is an exploded block diagram of the rotary electric machine stator according to the invention, which shows two types of cuff supports with different length protective shape portions, arranged on the stator core, and the phase coils inserted;

FIG. 4C is an exploded block diagram of the rotary electric machine stator according to the invention, which shows the phase coils bent using the cuff supports;

FIG. 4D is an exploded block diagram of the rotary electric machine stator according to the invention, which shows a neutral line provided with a temperature sensor; and

FIG. 4E is an exploded block diagram of the rotary electric machine stator according to the invention, which shows the temperature sensor arranged on the cuff support with the long protective shape portion, and fixed thereto by an adhesive.

DETAILED DESCRIPTION OF EMBODIMENTS

[0020] Hereinafter, an example embodiment of the invention will be described in detail with reference to the accompanying drawings. Below, a distributed winding is given as a winding method of a three phase coil, but this is only an example for the purpose of description. The winding may also be a concentrated winding or the like as long as a neutral line is used Also, the neutral line is described as being formed by a first neutral line that connects a neutral line side end portion of a U-phase coil to a neutral line side end portion of a V-phase coil, and two second neutral lines that connect the neutral line side end portion of the U-phase coil to a neutral line side end portion of a W-phase coil,

but this is only an example for the purpose of description. The connection method may be different than this as long as it connects together the neutral line side end portion of the U-phase coil, the neutral line side end portion of the V-phase, and the neutral line side end portion of the W-phase coil.

[0021] The dimensions, shapes, number of coils, and materials and the like are examples for the purpose of description, and may be modified as appropriate according to the specifications of the rotary electric machine stator. Hereinafter, like elements in the drawings will be denoted by like reference characters, and redundant descriptions will be omitted.

[0022] FIG. 1 is a block diagram of a rotary electric machine stator 10. This rotary electric machine stator 10 is a stator used in a three-phase synchronous rotary electric machine, in which various phase coils 14 are wound around a stator core 12 in a distributed winding. End portions on one side of the phase coils 14 are connected to a drive circuit, and the end portions on the other side of the phase coils 14 are connected together by neutral lines 16 and 18 using a Y-wiring system. A temperature sensor 30 for detecting a coil temperature is provided in the neutral line 16. Here, the temperature sensor 30 is fixed to the stator core 12 by an adhesive portion 50 (see FIG. 3) so that it will not swing from vibration.

[0023] FIG. 1 shows an axial direction, a radial direction, and a circumferential direction of the rotary electric machine stator. The axial direction indicates the one end side and the other end side.

[0024] The stator core 12 is an annular-shaped magnetic part that includes a base portion on an outer peripheral side, a plurality of teeth 60 that are arranged along in the circumferential direction on the inner peripheral side and that protrude in the radial direction, and a plurality of slots 62 that are air gaps that pass between adjacent teeth 60 in the axial direction. The teeth 60 and the slots 62 will be described later with reference to FIG. 4A.

[0025] A plurality of annular-shaped magnetic thin plates that formed in a predetermined shape including the teeth 60 and the slots 62, which are laminated together,

are used for the stator core 12. Electromagnetic steel plates may be used as the magnetic thin plates. Instead of a stacked body of magnetic thin plates, magnetic powder may also be integrally formed into a predetermined shape.

[0026] The phase coils 14 are stator coils that are wound around the stator core 12. The phase coils 14 formed by bending a conductor line that is covered with a suitable insulating coating in a predetermined shape, and arranging this extending between a plurality of slots 62 separated by predetermined slot intervals in the circumferential direction, by a distribution winding arranging method, so as to form a three-phase winding of the rotary electric machine stator.

[0027] A flat wire having a rectangular sectional shape is used as the conductor line with the insulating coating that is used for the phase coils 14. Using this flat wire makes it possible to improve the coil space factor in the slots 62. Wire having a circular cross-section or an elliptical cross-section may also be used instead of the flat wire.

[0028] A segment coil formed by a plurality of conductor segments is used as the phase coils 14. The conductive segments are formed by bending a conductor line of a predetermined length into a predetermined shape as necessary. As the conductor segments, U-shaped conductor segments in which a single conductor line is formed in a U-shape beforehand, or V-shaped conductor segments in which a single conductor line is formed in a V-shape beforehand, may be used because the conductor segments are arranged extending between a plurality of slots 62 that are separated by predetermined slot intervals in the circumferential direction.

[0029] A case in which V-shaped conductor segments are used will be described as an example. In this case, straight conductor portions that serve as both leg portions of the V shape are inserted one into each of two slots 62 that are separated by a predetermined slot interval in the circumferential direction, in the stator core 12. An apex portion of the V shape that connects these two leg portions together protrudes out toward one end side an axial direction of the stator core 12, and serves as a coil end portion on one end side. The two straight conductor portions corresponding to leg portions that are inserted into the two slots 62 protrude out toward the other end side in the axial direction of the stator core 12,

so these are bent appropriately and the tip end portions thereof serve as connecting end portions. Similarly, the other conductor segments are also bent appropriately at the other end side in the axial direction of the stator core 12 such that connecting end portions are formed. The connecting end portions and the like serve as coil end portions on the other end side of the stator core 12. Thus, the phase coils 14 of a distribution winding are able to be formed by electrically connecting the connecting end portions of the plurality of conductor segments that form same-phase coils together in series by a suitable connecting method such as welding.

[0030] The neutral lines 16 and 18 are conductor lines that connect neutral line side end portions of the phase coils 14 together. The neutral line 16 is a neutral line that connects the neutral line side end portion of the U-phase coil to the neutral line side end portion of the W-phase coil. This neutral line 16 will be referred to as the first neutral line. The neutral line 18 is a neutral line that connects the neutral line side end portion of the U-phase coil to the neutral line side end portion of the V-phase coil. This neutral line 18 will be referred to as the second neutral line. The neutral lines 16 and 18 are conductor lines with the same insulating coating used on the phase coils 14, but are conductor lines that connect the neutral line side end portions of the phase coils 14 together.

[0031] When the phase coils 14 are distinguished from each other by phase, they will be referred to as a U-phase coil 14_U, a V-phase coil 14_V, and a W-phase coil 14_W. The U-phase coil 14_U, the V-phase coil 14_V, and the W-phase coil 14_W are each connected at an end portion on one side to a corresponding terminal 20 on a drive circuit side. The end portions on the other side are connected together by the neutral lines 16 and 18 using a Y-wiring system. The terminals 20 on the drive circuit side are phase output terminals of the drive circuit, so when these are distinguished from each other by phase, they will be referred to as terminal 20_U, terminal 20_V, and terminal 20_W.

[0032] FIG. 2 is a view of the wiring method of the U-phase coil 14_U, the V-phase coil 14_V, and the W-phase coil 14_W. An end portion 14_{UT} on one side of the U-phase coil 14_U is connected to the terminal 20_U on the drive circuit side, and the end portion on the

other side of the end portion 14_{UT} serves as a neutral line side end portion 14_{UC} that is connected to a U-phase side end portion 16_U of one neutral line 16 and a U-phase side end portion 18_U of the other neutral line 18. An end portion 14_{VT} on one side of the V-phase coil 14_V is connected to the terminal 20_V on the drive circuit side, and the end portion on the other side of the end portion 14_{VT} serves as a neutral line side end portion 14_{VC} that is connected to a V-phase side end portion 18_V of the neutral line 18. Also, an end portion 14_{WT} on one side of the W-phase coil 14_W is connected to the terminal 20_W on the drive circuit side, and the end portion on the other side of the end portion 14_{WT} serves as a neutral line side end portion 14_{WC} that is connected to a W-phase side end portion 16_W of the neutral line 16.

[0033] In this way, the neutral line side end portion 14_{UC} of the U-phase coil 14_U, the neutral line side end portion 14_{VC} of the V-phase coil 14_V, and the neutral line side end portion 14_{WC} of the W-phase coil 14_W, are connected together by the two neutral lines 16 and 18.

[0034] The connections between the end portion 14_{UT} on one side of the U-phase coil 14_U, the end portion 14_{VT} on one side of the V-phase coil 14_V, and the end portion 14_{WT} on one side of the W-phase coil 14_W are done by welding. Also, the connections between the neutral line side end portion 14_{UC} of the U-phase coil 14_U, the neutral line side end portion 14_{VC} of the V-phase coil 14_V, and the neutral line side end portion 14_{WC} of the W-phase coil 14_W are also done by welding.

[0035] The temperature sensor 30 is a resin-molded thermistor, for example. The temperature sensor 30 is a resin package part that is arranged between the U-phase side end portion 16_U and the W-phase side end portion 16_W of the neutral line 16. The temperature sensor 30 passes through the neutral line 16 and has a thermistor 32 that is a temperature detecting element built in. Two detecting terminals 34 from the thermistor 32 are drawn out to the outside, and connected to a control unit or the like of the rotary electric machine.

[0036] Returning again to FIG. 1, cuff supports 40 are formed by a protective member, which is made of an insulator, such that the phase coils 14 that are wound inserted

into the slots 62 will not directly contact the end surface of the stator core 12 when they (i.e., the phase coils 14) are bent. These cuff supports 40 are arranged between the phase coils 14 and an end surface 13 of the stator core 12 in the axial direction.

[0037] Each cuff support 40 has a protective shape portion 42 that follows at least the outer peripheral side shape of the slot 62 (see FIG. 4B). For the cuff support 40, a long, thin flat plate part of suitable thickness, and that has a groove of the same planar shape as the planar shape of the air gap portion that passes through the slot 62, is able to be used as one part for each slot 62. The protective shape portion 42 is a shape of a portion that is contacted by the phase coils 14 that are inserted into these grooves, when the phase coils 14 are bent. The phase coils 14 are bent at the shoulders of the grooves, so a portion of a suitable width serves as the protective shape portion 42, starting from the shoulders of the grooves.

[0038] The cuff support described in JP 2006-223058 A is a protective jig that is arranged on the end surface 13 of the stator core 12, with a protective shape portion matching the through-portion shape of the slot 62, before the phase coils 14 are bent, and removed when the bending is finished. In contrast, the cuff support 40 in FIG. 1 is arranged on the end surface 13 of the stator core 12, a protective shape portion matching the through-portion shape of the slot 62, before the phase coils 14 are bent, and is not removed even after the bending is finished, but is instead left in a state fixed sandwiched between the end surface 13 of the stator core 12 and the bent phase coils 14. Therefore, the cuff support 40 is a component part of the rotary electric machine stator.

[0039] This cuff support 40 that is used may be formed by molding resin material having suitable heat resistant properties and strength into a predetermined shape. The resin material used may be epoxy resin or polycarbonate resin or the like.

[0040] As shown in FIG. 4B, a standard cuff support 40_S and a long cuff support 40_L are used as the cuff support 40. The difference between the two is the length of the protective shape portion 42 in the radial direction when they are arranged on the end surface 13 of the stator core 12. The length in the radial direction of a protective shape portion 42_L of the long cuff support 40_L is longer than the length in the radial direction of a

protective shape portion 42_S of the standard cuff support 40_S. In this way, the long cuff support 40_L has the protective shape portion 42_L that is longer than the standard type, so this will hereinafter be referred to as the "long protective shape portion 42_L". Here, the long cuff support 40_L is used in the location where the temperature sensor 30 is arranged.

[0041] All of the cuff supports 40 may be the long cuff supports 40_L, so they can all be one type. Also, the cuff support 40 does not need to be a separate part for each slot 62, but may instead be a single integrated part on the stator core 12. If the cuff support 40 is an integrated part, the separate parts may be integrated together by welding or the like after being arranged.

[0042] FIG. 3 is a view of the manner in which the temperature sensor 30 and the long cuff support 40_L are arranged. Here, only the W-phase coil 14_W that is connected to the neutral line 16 that passes through the temperature sensor 30 is shown. The other phase coils 14 are not shown. Here, the slot 62 of the stator core 12 is indicated by a broken line, and the long cuff support 40_L is arranged on the end surface 13 on the other end side of the stator core 12, with a groove 43 aligned with in a through-portion shape 63 of this slot 62.

[0043] Here, the position on the outermost peripheral side in the radial direction of the long cuff support 40_L is denoted by L_L, and the position on the outermost peripheral side in the radial direction when the standard cuff support 40_S is arranged is denoted L_S, for comparison. The long protective shape portion 42_L of the long cuff support 40_L is longer than the protective shape portion 42_S of the standard cuff support 40_S by $(L_L - L_S) = \Delta L$ in the radial direction. ΔL is set such that the position of a tip end portion on the outer peripheral side in the radial direction of the long cuff support 40_L extends into a gap between a lower surface 36 of the temperature sensor 30 and the end surface 13 of the stator core 12. Also, a thickness t of the long protective shape portion 42_L of the long cuff support 40_L need only be equal to or greater than the size of the gap between the lower surface 36 of the temperature sensor 30 provided on the neutral line 16 and the end surface 13 of the stator core 12.

[0044] As a result, the gap between the temperature sensor 30 provided on the

neutral line 16 and the end surface 13 of the stator core 12 is eliminated, so the lower surface 36 of the temperature sensor 30 is able to be supported by an upper surface 41 of the long cuff support 40_L.

[0045] By dripping adhesive into a portion defined by the upper surface 41 of the long protective shape portion 42_L of the long cuff support 40_L and a side wall surface 38 of the temperature sensor 30, the adhesive will accumulate and be inhibited from flowing out to the outer peripheral side. Therefore, this defined portion forms an adhesive accumulating portion.

[0046] An adhesive portion 50 is formed by dripping adhesive into the adhesive accumulating portion and letting it harden. As a result, the temperature sensor 30 and the long cuff support 40_L are firmly fixed by the hardened adhesive. Here, the long cuff support 40_L is fixed to the stator core 12, so the temperature sensor 30 is fixed by the adhesive to the stator core 12 via the long cuff support 40_L. A resin having suitable heat resistant properties may be used for the adhesive. For example, epoxy resin or the like may be used.

[0047] The adhesive accumulates between the temperature sensor 30 and the W-phase coil 14_W by the action of the adhesive accumulating portion, as shown in FIG. 3. Therefore, the temperature sensor 30 and the W-phase coil 14_W that is a stator coil are fixed together by the adhesive.

[0048] Even if a gap remains between the temperature sensor 30 and the long cuff support 40_L, the adhesive will fill in this gap and harden, so the temperature sensor 30 will be firmly fixed to the long cuff support 40_L. Also, even if the adhesive runs into a space between the lower surface of the temperature sensor 30 and the end surface 13 of the stator core 12 through this gap, it will harden, forming an adhesive portion 51, so the temperature sensor 30 will be firmly fixed to the end surface 13 of the stator core 12.

[0049] In this way, with the adhesive portions 50 and 51, at least a portion of the temperature sensor 30 is covered by adhesive, so the temperature sensor 30 is inhibited from being exposed to coolant for cooling the stator, or the like, for example. As a result, detection error by the temperature sensor 30 that may occur due to coolant dripping down

and contacting the temperature sensor 30 is able to be inhibited.

[0050] Also, the lower surface 36 of the temperature sensor 30 is supported by the upper surface of the long cuff support 40_L, so the height position of a W-phase side end portion 16_W of the neutral line 16 that passes through the temperature sensor 30 is stable. In FIG. 3, the height position of the W-phase side end portion 16_W of the neutral line 16 is denoted as H, based on the upper surface 41 of the long cuff support 40_L. By aligning this height position H with the height position of the neutral line side end portion 14_{WC} of the W-phase coil 14_W, the welding positions of the W-phase side end portion 16_W of the neutral line 16 and the neutral line side end portion 14_{WC} of the W-phase coil 14_W are aligned, which facilitates welding. In this way, the long protective shape portion 42_L of the long cuff support 40_L is a positioning reference when connecting the neutral point side end portion of each phase coil to the end portion of the neutral line.

[0051] This structure will now be described in further detail with reference to FIG. 3. FIG. 3 is an exploded view illustrating the steps when assembling the rotary electric machine stator 10. FIG. 4A is a view showing the relationship between the slots 62 and the teeth 60 of the stator core 12. As shown here, the teeth 60 are a plurality of protruding portions that protrude out in the radial direction on the inner peripheral side of the stator core 12, and are arranged in the circumferential direction. The slots 62 are air gaps that extend through in the axial direction, between adjacent teeth 60. The phase coils 14 are inserted into the slots 62 and wound around the teeth 60.

[0052] FIG. 4B is a view showing two types of cuff support 40, i.e., the standard cuff supports 40_S, and the long cuff supports 40_L, arranged on the stator core 12, with the U-phase coil 14_U, the V-phase coil 14_V, and the W-phase coil 14_W inserted. The length in the radial direction of the long protective shape portion 42_L of the long cuff supports 40_L is longer than the length in the radial direction of the protective shape portion 42_S of the standard cuff supports 40_S by ΔL (see FIG. 3).

[0053] FIG. 4C is a view of the U-phase coil 14_U, the V-phase coil 14_V, and the W-phase coil 14_W each bent, using the cuff supports 40_S and 40_L. The U-phase coil 14_U, the V-phase coil 14_V, and the W-phase coil 14_W are bent quite forcefully toward the end

surface 13 of the stator core 12, but the cuff supports 40_S and 40_L that are made of an insulator are arranged on the end surface 13 of the stator core 12, so the U-phase coil 14_U, the V-phase coil 14_V, and the W-phase coil 14_W will not directly contact the stator core 12.

[0054] FIG. 4D is a view of the neutral line 16 provided with the temperature sensor 30. The neutral line 18 is not shown in the drawings. FIG. 4E is a view of a state in which the lower surface 36 of the temperature sensor 30 is arranged on the long protective shape portion 42_L of the long cuff support 40_L, the adhesive portion 50 is formed using adhesive (see FIG. 3), and the temperature sensor 30 is fixed to the stator core 12. Here, the U-phase side end portion 18_U of the other neutral line 18 is shown connected by welding to the neutral line side end portion 14_{UC} of the U-phase coil 14_U and the U-phase side end portion 16_U of the neutral line 16.

CLAIMS:

1. A stator for a rotary electric machine, the stator comprising:

a stator core;

phase coils wounding around the stator core;

a neutral line connecting together one side end portion of each of the phase coil;

a temperature sensor provided on the neutral line, the temperature sensor arranged with a space between the temperature sensor and an end surface of the stator core; and

a cuff support arranged fixed to the end surface of the stator core, the cuff support made of an insulator, the cuff support and the temperature sensor being fixed by an adhesive.

2. The stator according to claim 1, wherein the temperature sensor and the phase coil are fixed together by the adhesive.

3. The stator according to claim 1 or 2, wherein

the temperature sensor and the end surface of the stator core are fixed together by the adhesive.

4. The stator according to claim 1, wherein

the adhesive accumulates in a portion defined by an upper surface of the cuff support and a side wall surface of the temperature sensor.

5. The stator according to claim 1, wherein a portion of the temperature sensor is covered by the adhesive.

6. The stator according to claim 1, wherein an upper surface of the cuff support is a positioning reference when connecting a neutral point side end portion of the phase coil to an end portion of the neutral line.

FIG. 1

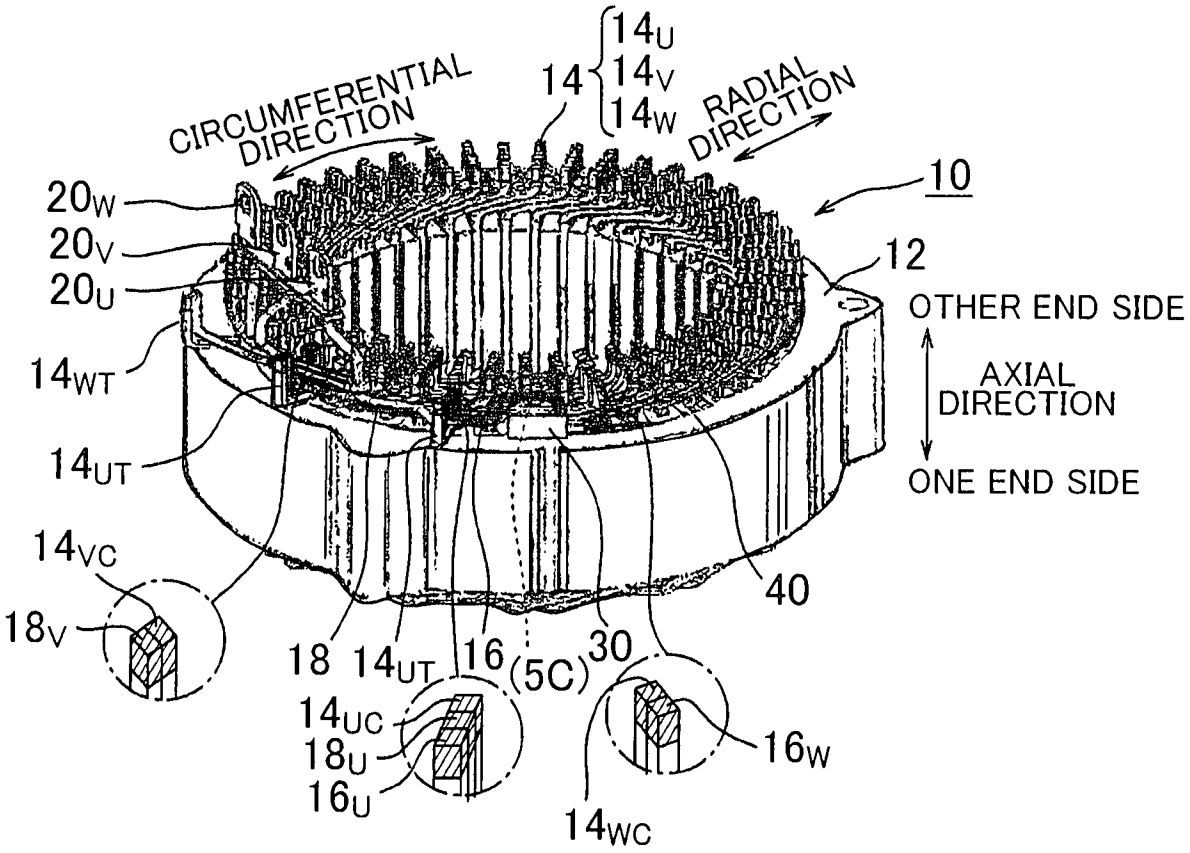

14U
14V
14W
14
CIRCUMFERENTIAL DIRECTION
RADIAL DIRECTION
10
20W
20V
20U
12
OTHER END SIDE
AXIAL DIRECTION
ONE END SIDE
14WT
14UT
14VC
18V
40
18
14UT
16
(5C)
30
14UC
18U
16U
16W
14WC

FIG. 2

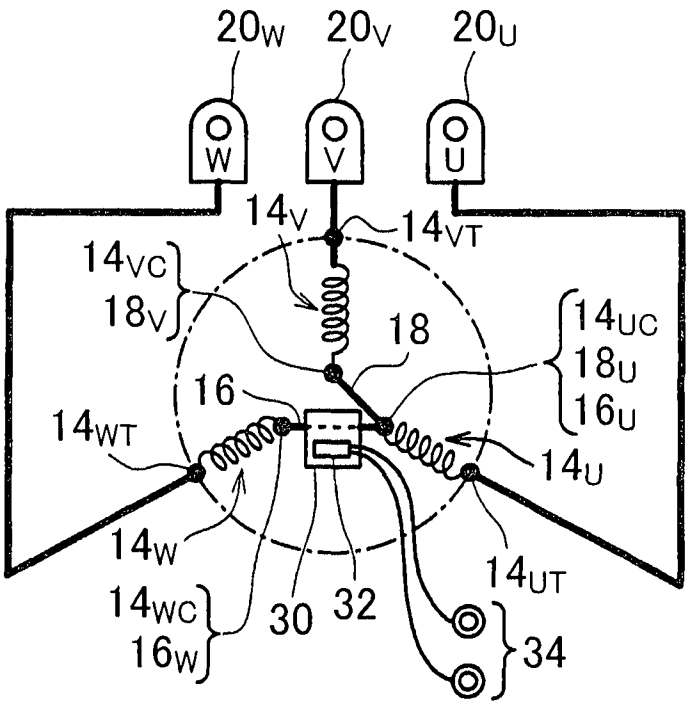

20W
20V
20U
W
V
U
14V
14VT
14VC
18V
18
14UC
18U
16U
16
14WT
14U
14W
14UT
14WC
16W
30
32
34

FIG. 3

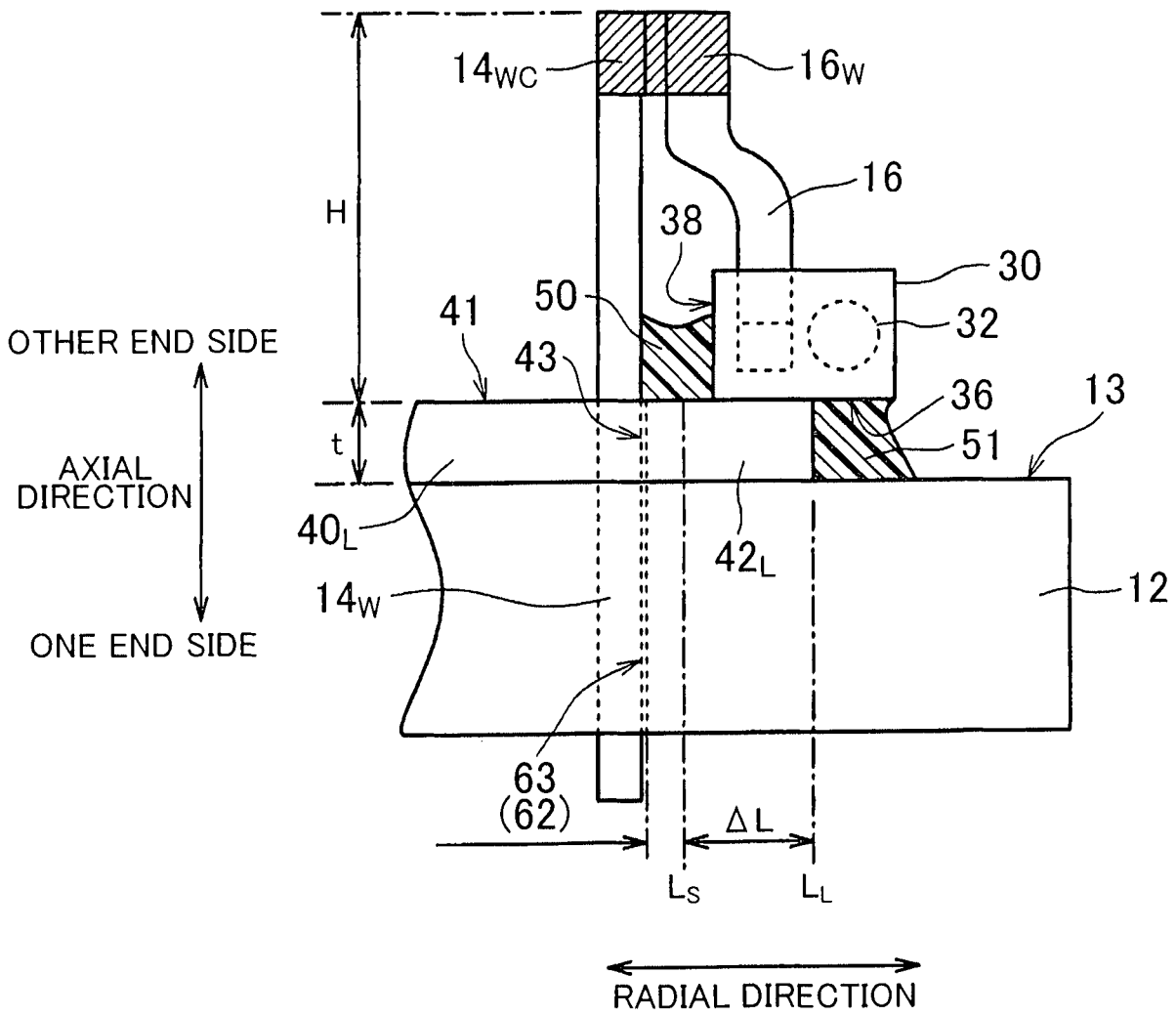

14_{WC}
16_W
16
38
30
50
41
32
43
36
13
51
H
t
OTHER END SIDE
AXIAL DIRECTION
ONE END SIDE
40_L
42_L
14_W
12
63
(62)
ΔL
L_S
L_L
RADIAL DIRECTION

FIG. 4A

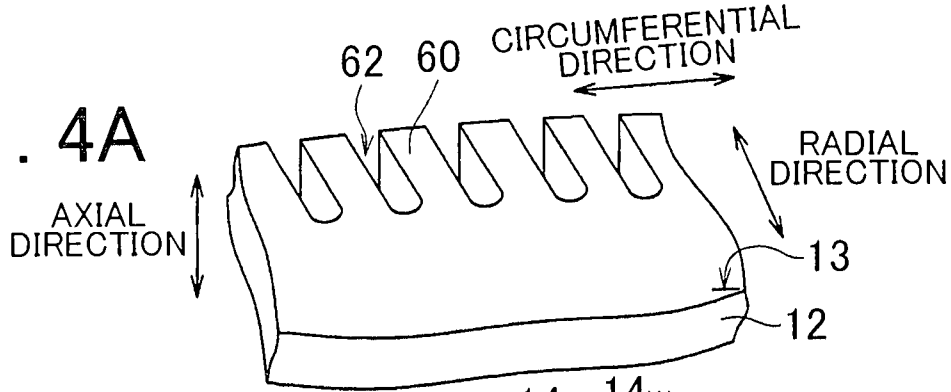


FIG. 4B

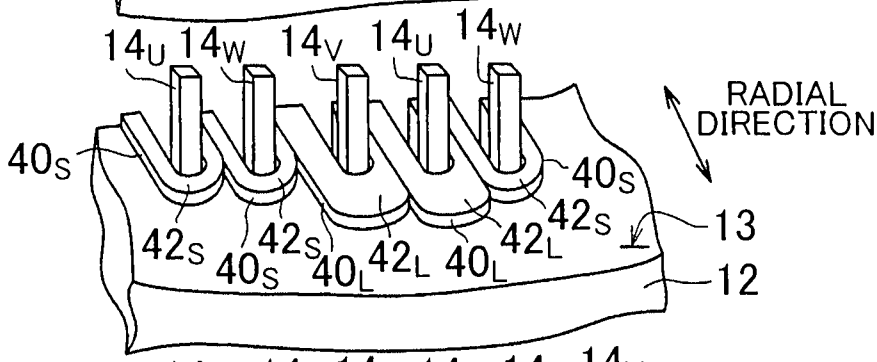


FIG. 4C

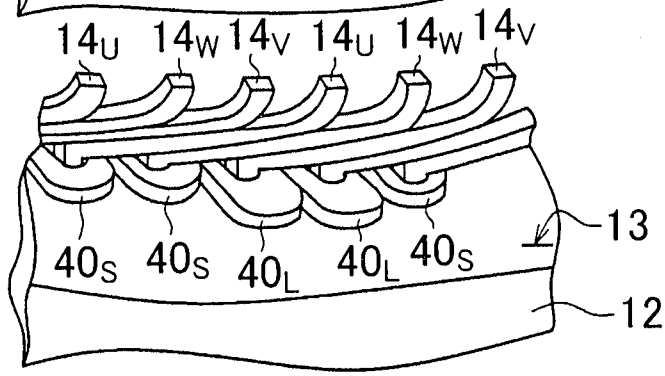


FIG. 4D

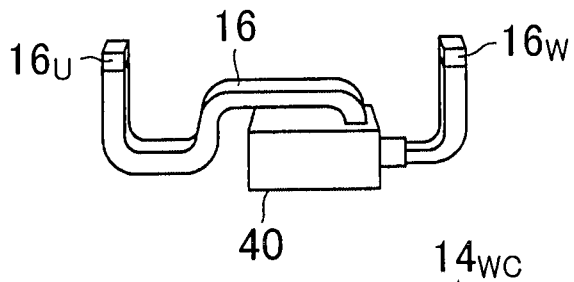
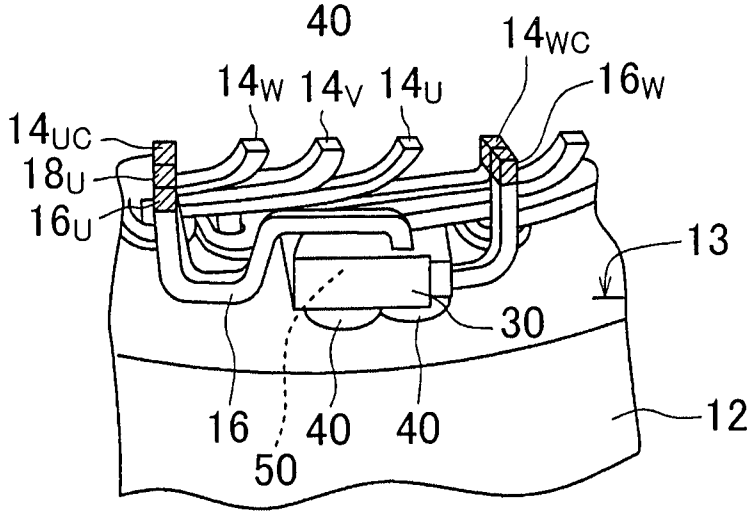


FIG. 4E



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/001851

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02K3/34 H02K3/50 H02K11/00
ADD.

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2013 121183 A (TOYOTA MOTOR CORP) 17 June 2013 (2013-06-17) cited in the application paragraph [0027] - paragraph [0030]; figures 1,3,5,8	1-6
Y	JP 2008 178222 A (TOYOTA MOTOR CORP) 31 July 2008 (2008-07-31) paragraph [0028] - paragraph [0035]; figures 1-6 abstract	1-6
A	JP 2004 281747 A (TOYOTA AUTO BODY CO LTD) 7 October 2004 (2004-10-07) abstract	1-6

-/--

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

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 January 2015	02/02/2015

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	Sedlmeyer, Rafael

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/001851

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/264757 A1 (ASOU HIROKI [JP] ET AL) 21 October 2010 (2010-10-21) paragraph [0048]; figure 2 paragraph [0052] - paragraph [0057]; figure 3	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/001851

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2013121183 A	17-06-2013	NONE	
JP 2008178222 A	31-07-2008	NONE	
JP 2004281747 A	07-10-2004	NONE	
US 2010264757 A1	21-10-2010	JP 4607964 B2	05-01-2011
		US 2010264757 A1	21-10-2010
		WO 2008105054 A1	04-09-2008