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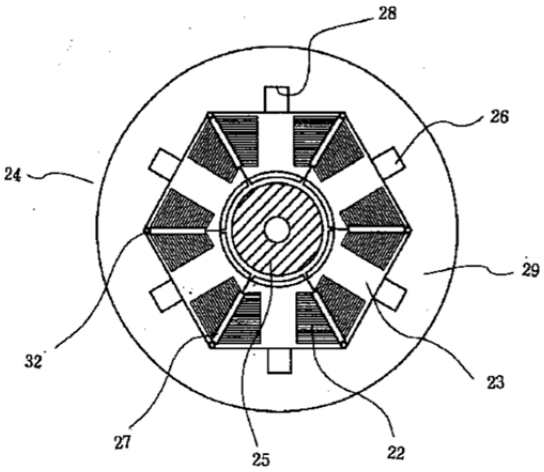
(71) Applicant 000003078
Toshiba Corporation
72-banchi, Horikawa-cho, Saiwai-ku, Kawasaki-shi, Kanagawa Prefecture

(72) Inventor HARUHIKO ISHIHARA
c/o Aichi Plant, Toshiba Corporation
991-banchi, Anada-cho, Seto-shi, Aichi Prefecture

(74) Agent Patent attorney NORIO ŌGO (and 1 other)

(54) (TITLE OF THE INVENTION) STATOR FOR ELECTRIC MOTOR AND MANUFACTURING METHOD THEREOF

(57) (ABSTRACT)
(SUBJECT) A stator for an electric motor comprises a component with attached and immobilized magnetic pole teeth and coil bobbins around which coils are wound, fitted into an annular stator core, and the manufacturing method thereof; specifically, a stator for an electric motor assembled by connecting coil bobbins, and the manufacturing method thereof.
(MEANS FOR SOLVING) Manufacture a coil bobbin unit 20 that connects a predetermined number of coil bobbins 23 by connection parts 32, and after wrapping winding wire 22 around each coil bobbin 23, assemble the stator 24 by fitting and immobilizing it in a stator core 29, within which the coil bobbin unit 20 is given an annular shape.



(SCOPE OF PATENT CLAIMS)
(CLAIM 1) An electric motor stator that is characterized by comprising a coil; a coil bobbin unit that is [firstly] composed of coil bobbins that are wound with this coil and have connection parts, and which [secondly] allows free rotating connection with other coil bobbins through said connection parts; magnetic pole teeth that are attached to and immobilized on said coil bobbins; and an immobilized iron core which, through said connection parts, fits into and holds the annular shape formed from a plurality of coil bobbin units to which said magnetic pole teeth are attached and immobilized.
(CLAIM 2) The electric motor stator described in Claim 1, characterized by having formed said connection parts in a structure that inlays their concave parts and convex parts in a rotatable manner.
(CLAIM 3) The electric motor stator described in Claim 1, characterized by having formed said connection parts with insertion pins and insertion holes.
(CLAIM 4) The electric motor stator described in Claim 1, characterized by having integrally molded said magnetic pole teeth and coil bobbins.
(CLAIM 5) The electric motor stator described in Claim 1, characterized by having said coil bobbins divided into two vertically symmetrical [groups] with respect to the axial direction of the rotor of the electric motor.
(CLAIM 6) The electric motor stator described in Claim 1, characterized by having provided in said coil bobbins protrusions and coil terminal connection parts that hold the connecting wire between in-phase coils.
(CLAIM 7) The electric motor stator described in Claim 1, characterized in that, when said coil bobbins are formed in an annular shape, flange parts that close the slots between adjacent coil bobbins are formed on said coil bobbins.
(CLAIM 8) The electric motor stator described in Claim 1, characterized by its provision of insulating dividers that link the connection parts of adjacent coil bobbins between said coil bobbins.
(CLAIM 9) The electric motor stator described in Claim 1, characterized by its formation of at least one of either said coil bobbins or said dividers out of electric insulating material with high magnetic permeability.
(CLAIM 10) Regarding the manufacturing method of an electric motor stator that comprises a component with attached and immobilized magnetic pole teeth and coil bobbins around which coils are wound, which is fitted into an annular stator core; a manufacturing method of an electric motor stator that is characterized by including a process to connect said coil bobbins in a band shape with only the predetermined number of connection parts, and a process to wrap winding wire around said coil bobbins.
(CLAIM 11) Regarding the manufacturing method of an electric motor stator that comprises a component with attached and immobilized magnetic pole teeth and coil bobbins around which coils are wound, which is fitted into an iron core with an annular yoke; a manufacturing method of an electric motor stator that is characterized by including a process for said coil bobbins to wrap winding wire around the stator, a process to connect the coil bobbins through connection parts, and a process to connect in-phase winding wire.
(DETAILED DESCRIPTION OF THE INVENTION)
(0001)
(TECHNICAL FIELD OF THE INVENTION) The present Invention relates to an electric motor stator and the manufacturing method thereof, [wherein the stator] comprises a component with attached and immobilized magnetic pole teeth and coil bobbins, formed by connecting several spools around which a coil is wound, which is fitted into an iron core with an annular yoke; specifically, it pertains to a stator for an electric motor and the manufacturing method thereof, which manufactures divided coil bobbins and connects and assembles them.
(0002)
(PRIOR ART) There are configurations such as the one described in Japanese Unexamined Patent Application Publication H7-245895 as an electric motor stator (stator) that uses coil bobbins. Namely, to explain according to Figure 10 and Figure 11, a stator (stator) 8 is composed of a stator core 1, a coil 4, and resin coil bobbins 5, while a rotor (rotor) 10 is inserted in the stator 8 and supported in a freely rotatable manner. A plurality of coil bobbins 5 are successively and integrally linked in a band at regular intervals by thin-walled parts 15a. It is enough that the material of the coil bobbins 5 is insulating; they do not necessarily have to be made of resin.
(0003) The manufacturing method of the stator 8 is, first of all, to attach magnetic pole teeth 2 to each coil bobbin 5. Although the magnetic pole teeth 2 are columnar, rotor-facing parts 2a are formed on one end in a shape that extends in a crescent. That is, the coil bobbins 5 are rounded into an annular shape contrary to the regular assembled state, by bending the thin-walled parts 15a so that the rotor-facing parts 2a of the magnetic pole teeth 2 that face the rotor 10 are on the outside; at the same time, if the rotor-facing parts 2a of the magnetic pole teeth 2 are immobilized in a position that brings them to a predetermined position on the winding wire member (not shown), then each coil bobbin 5 is connected on the side of the outer diameter and not on the side of the inner diameter, and thus the magnetic pole teeth 2 can open wide.
(0004) In this state, [the stator] is manufactured with the predetermined magnetic pole teeth 2 positioned on a reference line to which winding wire is applied, and with winding wire wound normally around the coil bobbins 5 by a winding machine. In addition, after all coil bobbins 5 have been wound, they are assembled on a stator core 1 according to the established assembly, to manufacture the stator.
(0005)
(PROBLEM TO BE SOLVED BY THE INVENTION) In a manufacturing method such as the above for an electric motor stator, a plurality of coil bobbins are successively, integrally molded at regular intervals as a coil bobbin unit linked in a band by thin-walled parts, and thus manufacturability is extremely poor because large molding dies are required to manufacture this coil bobbin unit.
(0006) Structurally as well, deformations such as displacement or distortion tend to occur when the coil bobbins are formed in an annular shape, so that it is necessary to assemble them by holding the coil bobbins or magnetic pole teeth with a jig. Furthermore, to ensure the insulation quality between the coils, it becomes necessary to ensure a certain spatial distance, causing a problem in that it becomes difficult to wind the coil with a high space factor.
(0007) The present Invention was created by focusing on the

manufacturability, that does not require large molding dies when manufacturing the coil bobbin unit.
(0008) In addition, [the purpose] is to provide an electric motor stator with ease of assembly because its construction does not produce deformations such as displacement or distortion, by ensuring that when the coil bobbins are formed in an annular shape, adjacent rotor-facing parts close the slots.
(0009) Furthermore, [the purpose] is to provide an electric motor stator that decreases the spatial distance for insulation by providing insulating dividers between adjacent coils.
(0010)
(MEANS FOR SOLVING THE PROBLEM) The present invention provides the stator of an electric motor comprising coils , a coil bobbin unit comprising coil bobbins about which coils are wound that have connection parts, said coil bobbin units being able to be coupled to other coil bobbins via the aforementioned connection parts so as to freely pivot with them, magnetic pole teeth to which the aforementioned coil bobbins are fitted and fixed, and a fixed core to which are mated and held in place a plurality of coil bobbin units to which the aforementioned magnetic pole teeth had been fitted and fixed, said units being formed in annular shape via the aforementioned connection parts.
(0011) The present Invention is also an electric motor stator that is characterized by having formed said connection parts in a structure that inlays their concave parts and convex parts in a rotatable manner.
(0012) The present Invention is also an electric motor stator that is characterized by having formed said connection parts with insertion pins and insertion holes.
(0013) The present Invention is also an electric motor stator that is characterized by having integrally molded said magnetic pole teeth and coil bobbins.
(0014) The present Invention is also an electric motor stator that is characterized by having said coil bobbins divided into two vertically symmetrical [groups] with respect to the axial direction of the rotor of the electric motor.
(0015) The present Invention is also an electric motor stator that is characterized by having provided in said coil bobbins protrusions and coil terminal connection parts that hold the connecting wire between in-phase coils.
(0016) The present Invention is also an electric motor stator that is characterized in that, when said coil bobbins are formed in an annular shape, flange parts that close the slots between adjacent coil bobbins are formed on said coil bobbins.
(0017) The present Invention is an electric motor stator that is characterized by its provision of insulating dividers that link the connection parts of adjacent coil bobbins between said coil bobbins.
(0018) The present Invention is also an electric motor stator that is characterized by its formation of at least one of either said coil bobbins or said dividers out of electric insulating material with high magnetic permeability.
(0019) Regarding the manufacturing method of an electric motor stator that comprises a component with attached and immobilized magnetic pole teeth and coil bobbins around which coils are wound, which is fitted into an annular stator core; the present Invention is also a manufacturing method of an electric motor stator that is characterized by including a process to connect said coil bobbins in a band shape with only the predetermined number of connection parts, and a process to wrap winding wire around said coil bobbins.
(0020) Regarding the manufacturing method of an electric motor stator that comprises a component with attached and immobilized magnetic pole teeth and coil bobbins around which coils are wound, which is fitted into an iron core with an annular yoke; the present Invention is also a manufacturing method of an electric motor stator that is characterized by including a process for said coil bobbins to wrap winding wire around the stator, a process to connect the coil bobbins through connection parts, and a process to connect in-phase winding wire.
(0021)
(EMBODIMENT OF THE INVENTION) The following embodiment of the Invention is described in reference to the drawings.
(0022) To describe [the embodiment] according to Figure 1 through Figure 8, typical motors are assembled with a stator and a rotor as shown in Figure 1 and Figure 2, as is common knowledge. The stator is constructed from a coil bobbin unit 20, which is constructed by linking multiple coil bobbins 23 to a stator core 29, formed by layering multiple magnetic steel sheets that have been punched out by a press or similar device; and [the stator] is constructed from magnetic pole teeth 26 that are attached to each coil bobbin 23. Concave parts 28 are formed on the inside of the ring-shaped stator core 29, in order to fit and immobilize the magnetic pole teeth 26. The magnetic pole teeth 26 are formed so that a gap 34 is created between the adjacent rotor-facing parts 26a when the concave part 28 is fitted and immobilized. Naturally, the inner dimensions of the stator core 29 are designed so that the annularly shaped coil bobbins 23 fit inside; meanwhile, flange parts 30 that are provided on the rotor-facing side of the coil bobbins 23 have been designed to touch the adjacent flange parts 30.
(0023) Figure 3 illustrates the structure of each coil bobbin unit 20 which is attached to magnetic pole teeth 26. It is the result of integrating the coil bobbins 23 in a band shape by connecting only a predetermined number of a single coil bobbin 23 or multiple coil bobbins 23, around which a coil 22 is wound, and which are connected by bendable thin-walled parts 23a, as shown in Figure 4, with connection parts 32. As shown in Figure 5 (a), the connecting part 32 has a configuration in which a coil bobbin 23 having a connecting portion 32a with a recessed profile at one end and a connecting portion 32b with a convex shape at the other end are mated so as to freely rotate. Using an engaging pin 33 and a pin hole 34 as shown in Figure 5(b) makes a hinge, producing a structure that connects in a freely rotating manner. With this structure, coil bobbins 23 can be put in contact at will. In addition, the number of coil bobbins 23 that are linked by the thin-walled parts 23a can be selected at will (this is possible as long as the number is fewer than the number of magnetic pole teeth 26, but taking into account factors such as manufacturability and the size of the molding dies, about two to four are adequate).
(0024) In addition, a coil bobbin unit 20 can be formed by a combination of a single coil bobbin 23 and multiple integrated coil bobbins 23.
(0025) Moreover, as shown in Figure 6, it is also possible to manufacture coil bobbins 23 by dividing them into top bobbins 23b and bottom bobbins 23c (with respect to the axial direction of the rotor of the electric motor), and manufacturing them to

be vertically symmetrical allows them to be made even smaller. Naturally, when winding wire, the wire is wound after assembling these components.

(0026) Furthermore, in this embodiment, the coil 22 is wound around the coil bobbin 23 after the magnetic pole teeth 26 are attached, but winding around can be performed at any time, such as after the coil 22 is wound around [sic], or before the magnetic pole teeth 26 are fitted and immobilized in the stator core 29.

(0027) To describe the situation of winding a coil 22 around a coil bobbin 23 according to Figure 7(a) and (b), first of all, the coil bobbin unit 20 is bent to be linear and toward the opposite direction from the time of assembly, widening the slots 27 that are between adjacent coil bobbins 23, thereby making it easier to wind the coil 22 inside a slot 27. In this state, the magnetic pole teeth 26 are aligned at regular intervals, and the in-phase coil 22 is subjected to successive concentrated winding around magnetic pole teeth 26 via a connecting wire 36. Since a terminal 38 and a connector are provided on the side of the stator core 29 of the coil bobbin 23 to connect a protrusion 37 and coil 22 that hold the connecting wire 36, after the coil 22 is wound around it, the coil bobbin 23 is rounded into an annular shape and inserted into the stator core 29 as shown in Figure 7(b). At that time, both ends of the coil bobbin unit 20 are linked and immobilized with a linking part 39, provided in advance.

(0028) Furthermore, when rounding into an annular shape, the slots 27 that were widened when winding the coil 22 can be closed by means of adjacent coil bobbins 23, the thin-walled parts 23a, and the flange parts 30 (however, in terms of the magnetic circuit, it is equivalent to an open magnetic circuit or a semi-open magnetic circuit). By this means, the coil bobbins 23 become linked and immobilized on the inner diameter and the outer diameter, making it unlikely for deformations such as distortion to occur, and making it easier to insert them into the stator core 29.

(0029) In addition, as shown in Figure 8, providing dividers 40 that insulate between the coils 22 and that take on the additional function of connection parts between the coil bobbins 23 means that there is no longer any need to set aside spatial distance to ensure insulation quality between the coils 22, allowing even more of the coil 22 to be wound, and improving the space factor.

(0030) Additionally, the material of the coil bobbins 23 is not limited to resin; any material can be used as long as it has high insulation properties, but by using insulating material with high magnetic permeability (e.g., plastic magnet or material that combines resin with iron oxide) for all of the coil bobbins 23 or for the dividers 40, the dividers 40 can be reused as auxiliary salient poles of the stator 24, reducing torque ripple and cogging torque.

(0031) Furthermore, after winding the coil 22 around the coil bobbins 23, it can also link the coil bobbins 23 in a band shape. That is, as shown in Figure 9, after attaching magnetic pole teeth 26 to a coil bobbin 23, the coil 22 can also be wound around [them]. In such a case, it would be advisable to provide a terminal 38 to connect (immobilize) the winding start and the winding end of the coil 22 around the coil bobbin 23, so that it is easier to connect between the coils 22. After the coil bobbins 23 are linked in a band shape, the coil bobbin unit 20 is rounded into an annular shape, and the outside of the magnetic pole teeth 26 is fitted into the concave parts 28 inside the stator core 29 to immobilize it, in the same way as the embodiment previously described.

(0032) Moreover, it need scarcely be mentioned that a variety of additional modified implementations are available that do not deviate from the intent of the present Invention.

(0033)

(EFFECT OF THE INVENTION) Because the present Invention enables a coil bobbin unit to be assembled in connection with a predetermined number of coil bobbins as needed, it can be manufactured with compact molding dies, rendering unnecessary the large molds required to integrally mold a coil bobbin unit of the conventional variety; moreover, even if there is low quality in the yield, the parts can be interchanged.

(0034) Because the present Invention also changes the coil bobbin connection parts so that they freely rotate, the gaps between adjacent coil bobbins can be made wider when winding the coil around the coil bobbin, and their condition can be configured at will; therefore, winding the coil becomes extremely easy, and the coil space factor can be increased.

(0035) Because the present Invention also has the coil bobbins and magnetic pole teeth integrally molded, assembly becomes easy, and assembly precision can be improved.

(0036) Because the present Invention has also divided the coil bobbins into two vertically symmetrical [groups] with respect to the axial direction of the electric motor, their molding dies can be made more compact.

(0037) Because the present Invention has also provided protrusions and coil terminal connection parts to hold the connecting wire of in-phase coils in the stator core, the ease of assembly can be improved for the stator.

(0038) Because the present Invention also provides flange parts on the coil bobbins, the slots can be closed by the flange parts on adjacent coil bobbins when shaping the coil bobbin unit into a circle, which has vastly improved the ease of assembly of the stator.

(0039) Because the present Invention also provides dividers that insulate between the coils between coil bobbins, these can reduce the insulation space and also be used as auxiliary salient poles for the stator.

(0040) Because the manufacturing method of the electric motor stator under the present Invention [uses] a winding wire that links a predetermined number of coil bobbins in a band shape, winding the coil becomes extremely easy, and handling the connecting wire becomes easier[.] In addition, the coil space factor can be increased, and the manufacturing costs of the stator and electric motor can be reduced.

(0041) Because the manufacturing method of the electric motor stator under the present Invention connects the coil bobbins when the winding wire has been wound around them, the electric motor stator can be assembled easily.

(BRIEF DESCRIPTION OF THE DRAWINGS)

(FIGURE 1) Top view of the principal parts of the electric motor stator according to the embodiment of the Invention

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