(19) Japan Patent Office (JP) (12) Publication of Patent Application (A) (11) Published Patent Application Number
Japanese Patent Application Laid-open No. 2000-184635 (P2000-184635A)
(43) Publication date: June 30th, 2000

(51) Int.Cl.[7]	Identification Code	F1	Theme code (reference)
H02K 1/18		H02K 1/18	C 5H002
21/14		21/14	M 5H621

Examination requested: none Number of claims: 3 (7 pages in total)

(21) Application No.: H10-360379

(22) Application Date:
December 18th, 1998 (1998. 12. 18)

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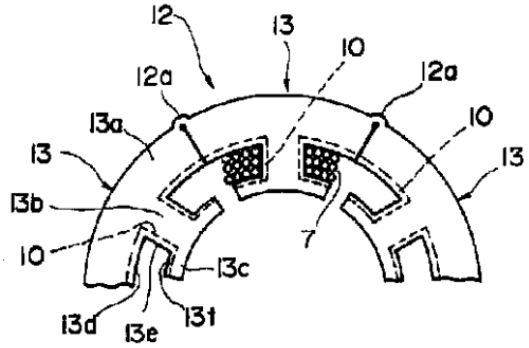
F term (reference) : 5H002 AA07 AB01 AE08
5H621 GA01 GA04 GB10 HH01 JK01

(54)Title of the Invention: MOTOR

(57) [Abstract]
[Object] A “motor” with excellent reliability and durability can be provided through an assembling/manufacturing operation involving a small number of steps.
[Solving means] A motor includes: a stator including a stator core and a wound coil 7; and a rotor disposed on an inner side of the stator. The stator core includes: a plurality of divided core blocks 10 each including a yoke portion and a salient pole protruding from the yoke portion that are integrally formed; and a divided core holding member 12 in a form with a plurality of holding portions 13, holding the divided core blocks 10 in an arranged form, sequentially coupled to each other via deformable portions 12a that are deformable. The divided core holding member 12 that cover the salient pole of each of the divided core blocks 10 and a portion therearound, and a wound coil 7 is insulated from the divided core block 10 by a part 13b and 13d to 13f of the covering portions.
[FIG. 5]



[Claims]
[Claim 1] A motor (1) comprising:
a stator (3) including a stator core (6) and a wound coil (7); and a rotor (2) disposed on an inner side of the stator, wherein the stator core includes: a plurality of divided core blocks (10) each including a yoke portion (11a) and a salient pole (11b) protruding from the yoke portion that are integrally formed; and a divided core holding member (12) in a form with a plurality of holding portions (13), holding the divided core blocks in an arranged form, sequentially coupled to each other via deformable portions (12a) that are deformable.
[Claim 2] The motor according to claim 1, wherein the divided core holding member (12) includes an insulting covering portion (13b, 13d, 13e, 13f) that covers a portion of each of the divided core blocks (10) where the wound coil (7) is attached.
[Claim 3] The motor according to claim 2, wherein the divided core block (10) is held by the divided core holding member with a part (11b) of the divided core block press fitted in the covering portion (13e) of the divided core holding member (12).
[Detailed Description of the Invention]
[0001]
[Technical field to which the present invention pertains] The present invention relates to a motor, and particularly relates to a structure of a stator of an inner rotor type motor.
[0002]
[Conventional technique] Generally used inner rotor type motors have a rotor, including a permanent magnet, disposed on the inner side of a stator formed with a wound coil attached to a stator core. The stator disposed on the outer side of the rotor has a plurality of salient poles, protruding inward in a radial direction, integrally provided on a yoke portion having an annular shape (cylindrical shape). The coil may be directly wound around the salient pole, or the wound coil that has already been wound may be attached to the salient pole. The rotor is formed with a rotor core, to which a plurality of the permanent magnets are fixed, integrally attached to a rotational shaft as an output shaft, and is inserted and disposed on the inner side of the stator. The rotor is rotated by electromagnetic force generated with the wound coil provided to each salient pole energized as appropriate.
[0003] In some cases, such a motor is manufactured with a stator core 51 in a form illustrated in Fig. 8 for reducing the number of manufacturing steps and cost. Specifically, a plurality of core plates 52, each including an annular yoke portion 52a and a plurality of salient poles 52b protruding inward in the radial direction from the yoke portion 52a, are formed by punching a magnetic metal plate with a press machine, and are stacked and integrated.
[0004] The salient poles (stacked salient poles 52b) of the stator core 51 protrude inward from the annular yoke portion (the stacked yoke portions 52a) on the outer side. Thus, the winding of the coil or the attaching of the wound coil needs to take place on the inner side of the stator core 51 (a portion where the rotor is to be inserted and disposed). However, such a space on the inner side of the stator core 51 is small, and thus the operation of winding the coil or attaching the wound coil is not easy and requires a large number of work steps. Furthermore, the number of coils is limited in some cases.
[0005] In view of the above, the following technique has been proposed. Specifically, divided core blocks 54 as illustrated in Fig. 9 are formed with a plurality of divided pieces (divided core plates) 53, formed by dividing (splitting) the core plate 52 illustrated in Fig. 8 at portions of the yoke portion 52a each being at approximately the middle of a section between each two adjacent salient poles 52b, stacked and integrated. After the coil is wound around or the wound coil is attached to the stacked salient poles 53b of the divided core block 54, the divided core blocks 54 are arranged to be in an annular form with adjacent yoke portions 53a in contact with each other, and then welding is performed between the stacked yoke portion 53a of each adjacent divided core blocks 54 so that an integrated structure can be established.
[0006] The portion of the divided core block to be provided with the wound coil is coated with insulating resin to guarantee insulation from the wound coil, and the wound coil is attached to the coated portion.
[0007]
[The problem to be solved by the invention] The conventional technique described above, in which the stator core is formed with the divided core blocks arranged in an annular form are welded and fixed to each other at the yoke portions, has

performed and the number of coils can be increased. Still, the welding operation, which is an essential aspect, is not something that can be easily performed, and involves heat or the like that might damage the wound coil. An error in the welding operation might lead to insufficient fixing between the yoke portions, leading to a brittle structure, resulting in low reliability and low durability. The operation of coating the portion of the divided core block where the wound coil is to be attached is a cumbersome operation also resulting in an increased number of operation steps.

[0008] The present invention is made in view of the problems of the conventional technique described above, and an object of the present invention is to provide a motor with excellent reliability and durability that can be assembled/manufactured with a small number of operation steps.

[0009]

[Means for solving the problem] 1. A motor according to claim 1 for achieving the object includes: a stator including a stator core and a wound coil; and a rotor disposed on an inner side of the stator, wherein the stator core includes: a plurality of divided core blocks each including a yoke portion and a salient pole protruding from the yoke portion that are integrally formed; and a divided core holding member in a form with a plurality of holding portions, holding the divided core blocks in an arranged form, sequentially coupled to each other via deformable portions that are deformable. In this configuration, although not limited, the yoke portion may have a substantially arch form, and the salient pole may be formed to protrude inward in a radial direction from the yoke portion.

[0010] In the invention according to claim 1, the plurality of divided core blocks are prepared, and are held by the divided core holding member with the deformable portions deformed as appropriate to achieve an easier operation. In this state, a coil wire is wound around the salient pole of each divided core block or the wound coil is attached to the salient pole. The wound coil may be attached to the salient pole before the divided core holding member holds the divided core block.

[0011] Then, the divided core holding members, holding the divided core blocks, are deformed at the deformable portions to have the holding members arranged in a substantially annular form. Thus, the yoke portions of the divided core block are formed into a substantially annular form with the salient poles substantially oriented toward the center. In this state, both end portions of the divided core holding members are joined and fixed to each other, and thus the stator is formed.

[0012] Thus, the divided core blocks are not integrated by welding as in the conventional technique, and are integrated via the divided core holding members, whereby assembling and manufacturing operations can be extremely easily performed with a much smaller number of operation steps. With no welding operation performed, the configuration is free of risks such as the wound coil being damaged by heat or an erroneous welding operation or insufficient welding resulting in a failure to achieve a sufficiently high strength of the stator, and thus can achieve high reliability and durability.

[0013] The wound coil can be easily attached to the divided core block held by the holding member of the divided core holding member, or the divided core block in a state of not being held. Thus, the wound coil can be attached with an easy operation, and the number of operation steps can be reduced. The operation of attaching the wound coil is less likely to be hindered by the other salient poles. Thus, the number of times the coil wire is wound can be increased, and the motor can have an increased output or can be downsized.

[0014] 2. Although not limited, in the invention described above, the divided core holding member includes insulting covering portion that covers a portion of each of the divided core blocks where the wound coil is attached, as in the motor according to claim 2.

[0015] The portion of the stator core where the wound coil is attached may be coated and insulated with resin or the like to guarantee insulation from the wound coil. The invention according to claim 2 features the divided core holding member including the covering portions so that the insulating coating operation can be omitted, whereby the number of operation steps in the assembling/manufacturing operation of the motor can be reduced.

[0016] 3. Although not limited, in the invention described above, the divided core block is held by the divided core holding member with a part of the divided core block press fitted in the covering

the motor according to claim 3.

[0017] The divided core block is held by the covering portions of the divided core holding member. Thus, the covering portions have both the insulating covering function and a function of holding the divided core block, whereby a more simple and efficient configuration can be achieved compared with a configuration where a structure of holding the divided core block is provided separately from the covering portion.

[0018]

[Mode for carrying out the invention] An embodiment of the present invention is described below with reference to the drawings. Fig. 1 is a perspective view illustrating a main part of a motor according to the embodiment of the present invention. Fig. 2 is a perspective view of a stator core according to the embodiment of the present invention. Fig. 3 is a plan view of a divided core plate forming the stator core according to the embodiment of the present invention. Fig. 4 is a plan view of a main part of the stator core before being formed into an annular form according to the embodiment of the present invention. Fig. 5 is as plan view illustrating a main part of the stator core after being formed into the annular form according to the embodiment of the present invention. Fig. 6 is a cross-sectional view taken along line vi-vi in Fig. 4. Fig. 7 is an exploded cross-sectional view of Fig. 6.

[0019] First of all, an overall schematic configuration of a motor according to this first embodiment is described with reference to Fig. 1. This motor 1 includes: a rotor 2 as a rotating member; a stator 3 as a fixed member; and an unillustrated motor housing incorporating these components; and the like.

[0020] The rotor 2 is formed with an output shaft (shaft) 5 inserted in a through hole formed at the center of the rotor core 4 to be integrally fixed. A plurality of permanent magnets (not illustrated) having a flat plate form or a curved (arch shaped) plate form are attached to the rotor core 4. The output shaft 5 of the rotor 2 is supported by the motor housing.

[0021] The stator 3 includes: a stator core 6 having a substantially cylindrical shape; and a plurality of wound coils 7. The stator core 6 is formed with a plurality of salient poles 9, protruding inward in a radial direction, which are integrally formed on an inner side of the yoke portion 8 having a substantially cylindrically shape, in such a manner that a slot is formed between each adjacent salient poles 9. The stator 3 is fixed to an inner side of the motor housing.

[0022] The rotor 2 is inserted and disposed while being separated from the salient poles 9 of the stator core 6 with a predetermined gap provided in between. The wound coils 7 are each wound around a corresponding one of the salient poles 9 of the stator core 6. When the wound coils 7 are energized by being provided with current at a predetermined timing, the rotor 2 is rotated by an electromagnetic action achieved with the permanent magnets of the rotor 2.

[0023] Next, a structure and a manufacturing method of the stator core 6 are described with reference to Figs. 2 to 7. The stator core 6 includes: a plurality of (eight in Fig. 2) divided core blocks 10 each formed by stacking and integrating a plurality of divided core plates 11; and a pair of divided core holding members 12 that integrally holds a divided core block 10 in an annular arrangement.

[0024] As illustrated in Fig. 3, the divided core plates 11 each include: a divided yoke portion 11a formed to have a substantially arch shape; a salient pole 11b protruding inward in the radial direction from the divided yoke portion 11a; and an arch portion 11c formed at a distal end portion of the salient pole 11b to have a substantially arch form. The plate with these components integrally formed is manufactured by punching a magnetic metal sheet with a press machine.

[0025] Although not elaborated in the figure, one or a plurality of half-pierces (embosses) are further formed on the divided yoke portion 11a and/or the salient pole 11b of the divided core plate 11 by the processing by the press machine. The half-pierce includes a protrusion formed on one surface of the divided core plate 11 and a recess formed at a corresponding portion on the other surface. The protrusion is formed to have a shape capable of being fitted or press fitted in the recess. The thickness of the divided core plate 11 is not particularly limited. In this embodiment, the thickness is set to be about 0.5 mm.

[0026] The plurality of the divided core plates 11 each having the configuration described above are prepared, and the divided core plates 11 are stacked and integrated with the half-pierce (protrusion) of one plate press fit in the half-pierce of another one of the plates. Thus, the divided

divided yoke portion) including the stacked divided yoke portions 11a; salient poles (the stacked salient poles) 9 including the stacked salient poles 11b; and an arch portion obtained by stacking (stacked arch portion) 11c.

[0027] As illustrated in Fig. 4 to Fig. 7, the divided core holding member 12 includes a plurality of holding portions 13 for holding the divided core block 10 that are arranged on a single line and are coupled to each other in series via thin deformable portions 12a. The adjacent holding portions 13 can pivot with each other with the deformable portion 12a deformed.

[0028] The holding portions 13 of the divided core holding member 12 each include: a yoke end surface covering portion 13a that is in a flat plate form with substantially the same shape as the yoke portion 11a of the divided core block 10; a salient pole end surface covering portion 13b that is in a flat plate form with substantially the same shape as the salient pole 11b of the divided core block 10; an arch end surface covering portion 13c that is in a flat plate form with substantially the same shape as the arch portion 11c of the divided core block 10; a pair of yoke side surface covering portions 13d for covering side surfaces of the yoke portion 11a of the divided core block 10 on the side of the salient pole 11b; a pair of salient pole side surface covering portions 13e in a flat plate form for covering both side surfaces of the salient pole 11b of the divided core block 10; and a pair of arch side surface covering portions 13f in an arch plate form for covering side surfaces of the arch portion 11c of the divided core block 10 on the side of the salient pole 11b, and is integrally formed by molding using an insulating thermoset resin material. Examples of the resin material that can be used for the divided core holding member 12 include polybutylene terephthalate (PBT) and polyethylene terephthalate (PET).

[0029] As illustrated in Fig. 7, the divided core block 10 is held by the holding portions 13 of the divided core holding members 12, with a corresponding portion inserted or press fitted in a pair of rectangular U shaped portions of the divided core holding member 12, each defined by each of the pair of yoke side surface covering portions 13d, the salient pole side surface covering portion 13e, and the arch side surface covering portion 13f, in such a manner that the yoke portion 11a, the salient pole 11b, and the arch portion 11c respectively have end surfaces in contact with the yoke end surface covering portion 13a, the salient arch end surface covering portion 13c from the inner side.

[0030] The plurality of divided core blocks 10 are held by being clamped between the pair of divided core holding member 12 in an upper and lower direction, and are in the state where the holding portions 13 are, for example, substantially arranged on a single line by being pivoted with the deformable portions 12a deformed as illustrated in Fig. 4 for the sake of workability. In this state, the coil is wound around the salient pole 11b (9), covered by the covering portions 13b and 13e of the divided core block 10 to be insulated, with a dedicated or a general purpose winder or manually. Thus, the wound coil 7 is formed, and is fixed with resin soaked into the wound coil 7 or through other suitable ways. The wound coil 7 may be attached to the salient pole 11b of the divided core block 10 with the wound coil 7, wound in advance, attached to the salient pole 11b.

[0031] The divided core holding member 12, to which the wound coils 7 are attached, holding the plurality of divided core blocks 10 has the holding portions 13 pivoted about the deformable portions 12a to be in an annular form, in such a manner that the yoke portions 11a of the divided core block 10 form a substantially annular form with the salient poles 11b oriented toward the center. In this state, a gap is formed between each adjacent arch portions 11c.

[0032] Next, both end portions of the pair of divided core holding members 12 are joined and fixed to each other, whereby the stator core 6 (stator 3) in an annular form as illustrated in Fig. 2 and Fig. 5 is manufactured. How both end portions of the divided core holding members 12 are joined is not particularly limited, and fixing using an adhesive 14 (see Fig. 2) may be employed for example. Alternatively, engagement portions that engage with each other may be formed in advance on both end portions of the divided core holding members 12, and the fixing may be achieved with the engagement portions. Furthermore, the joined portions may be welded to each other.

[0033] In the present embodiment as described above, the plurality of divided core block 10 are clamped by the pair of divided core holding members 12 to be held by the holding portions 13, and the pair of divided core holding members 12 have their both end portions joined and fixed to each other to be integrated, whereby the stator 3

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