to improve the torque and the efficiency.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0009]

Patent Document 1: Japanese Patent Application Laid-Open Publication No. 2006-121821

Patent Document 2: Japanese Patent Application Laid-Open Publication No. 2009-194945

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0010]

However, according to the configuration of the rotor of the SynRM, layers of flux barriers that are large in magnetic resistance need to be disposed to increase a salient pole ratio (Lq / Ld) in order to increase the torque and the power factor.

[0011]

According to the configuration of the conventional SynRM, in its structure, the width of a magnetic path on the side of an upper layer (or in a radial-direction outer-side portion perpendicular to the axis of the rotor) of multi-layered magnetic paths is relatively narrow. Accordingly, the problem is that a large magnetic resistance occurs locally, leading to a decrease in the q-axis inductance (Lq) of the entire rotor and resulting in a drop in the torque and the power factor.

[0012]

Embodiments of the present invention have been made to solve the above problems. Embodiments of the present invention raise the salient pole ratio (Lq / Ld) of the synchronous reluctance motor and increase the torque and power factor.

MEANS FOR SOLVING THE PROBLEM

[0013]

According to a first aspect of the present invention, there

is provided a synchronous reluctance motor comprising: a rotor shaft which is supported in a rotatable manner and axially extends at a rotation axis; a rotor core shaped in a cylindrical form including a bridge portion on an outer peripheral portion thereof, on which a plurality of flux barriers are formed and which is disposed at outer circumference of the rotor shaft and fixed to the rotor shaft and extends in the direction of the rotation axis; a stator core which is disposed on an outer periphery of the rotor core in such a way as to form a gap between the rotor core and the stator core and on which a plurality of protruding stator teeth are formed in such a way as to be spaced out in a circumferential direction each other and extend in the direction of the rotation-axis; and multiphase armature windings of a plurality of poles which are wound around the plurality of stator teeth, wherein the flux barriers include a plurality of first flux barriers which are formed in such a way as to be spaced out in the circumferential direction each other and extend in a radial direction, and a plurality of second flux barriers which are formed in each of circumferential angular regions sandwiched between the first flux barriers in such a way as to form a curved surface protruding toward the center of the rotation-axis and to spread and be mutually spaced out in the circumferential direction, the rotor shaft includes a plurality of radial plates which are made of nonmagnetic material and spaced out in the circumferential direction and which extend toward a radial-direction outer side and extend in the direction of the rotation-axis and disposed in the first flux barriers and, projections are formed at least in one of the rotor core and the radial plates and grooves are formed in another for mutual fitting.

[0014]

According to a second aspect of the present invention, there is provided a rotor of a synchronous reluctance motor equipped with a stator core including an armature winding, comprising: a rotor shaft which is supported in a rotatable manner and axially extends at a rotation axis; and a rotor core shaped in a cylindrical form including a bridge portion on an outer peripheral portion thereof, on which

a plurality of flux barriers are formed and which is disposed at outer circumference of the rotor shaft and fixed to the rotor shaft and extends in the direction of the rotation axis, wherein the flux barriers include a plurality of first flux barriers which are formed in such a way as to be spaced out in the circumferential direction each other and extend in a radial direction, and a plurality of second flux barriers which are formed in each of circumferential angular regions sandwiched between the first flux barriers in such a way as to form a curved surface convex toward the rotation-axis center and to spread and be spaced out in the circumferential direction ~~each other~~the rotor shaft includes a plurality of radial plates which are made of nonmagnetic material and spaced out in the circumferential direction and which extend toward a radial-direction outer side and extend in the direction of the rotation-axis and disposed in the first flux barriers and, projections are formed at least in one of the rotor core and the radial plates and grooves are formed in another for mutual fitting.

ADVANTAGE OF THE INVENTION

[0015]

According to embodiments of the present invention, it is possible to raise the salient pole ratio (Lq / Ld) of the synchronous reluctance motor and increase the torque and power factor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a cross-sectional view of a synchronous reluctance motor, which is perpendicular to the direction of a rotation axis, according to a first embodiment.

FIG. 2 is a detailed, partial cross-sectional view of the synchronous reluctance motor, which is perpendicular to the direction of the rotation axis, according to the first embodiment.

FIG. 3 is a wiring diagram of armature windings of the synchronous reluctance motor according to the first embodiment.

CLAIMS

1 A synchronous reluctance motor comprising:

a rotor shaft which is supported in a rotatable manner and axially extends at a rotation axis;

a rotor core shaped in a cylindrical form including a bridge portion on an outer peripheral portion thereof, on which a plurality of flux barriers are formed and which is disposed at outer circumference of the rotor shaft and fixed to the rotor shaft and extends in the direction of the rotation axis;

a stator core which is disposed on an outer periphery of the rotor core in such a way as to form a gap between the rotor core and the stator core and on which a plurality of protruding stator teeth are formed in such a way as to be spaced out in a circumferential direction each other and extend in the direction of the rotation-axis; and

multiphase armature windings of a plurality of poles which are wound around the plurality of stator teeth, wherein

the flux barriers include

a plurality of first flux barriers which are formed in such a way as to be spaced out in the circumferential direction each other and extend in a radial direction, and

a plurality of second flux barriers which are formed in each of circumferential angular regions sandwiched between the first flux barriers in such a way as to form a curved surface protruding toward the center of the rotation-axis and to spread and be mutually spaced out in the circumferential direction,

the rotor shaft includes a plurality of radial plates which are made of nonmagnetic material and spaced out in the circumferential direction and which extend toward a radial-direction outer side and extend in the direction of the rotation-

axis and disposed in the first flux barriers and,

projections are formed at least in one of the rotor core and the radial plates and grooves are formed in another for mutual fitting.

~~2. The synchronous reluctance motor according to claim 1, wherein:~~

~~the rotor shaft includes a plurality of projecting portions which are made of nonmagnetic material and spaced out in the circumferential direction and which extend toward a radial direction outer side and extend in the direction of the rotation axis each other; and~~

~~the convex portions are disposed in the first flux barriers.~~

~~3. The synchronous reluctance motor according to claim 2, wherein~~

~~fitting portions are formed on the projecting portions and the rotor core in order to prevent a positional shift therebetween.~~

4~~1~~2. The synchronous reluctance motor according to claim ~~1~~3, wherein

the projections for fitting ~~portions~~ are dovetail-shaped.

5~~1~~3. The synchronous reluctance motor according to ~~any one of claims 1 to 4~~ claim 1 or 2, wherein

at least the first flux barriers or the second flux barriers are filled with nonmagnetic resin.

~~64~~. The synchronous reluctance motor according to any one of claims 1 to ~~53~~, wherein

air layers are formed in at least the first flux barriers or the second flux barriers.

~~75~~. The synchronous reluctance motor according to any one of claims 1 to ~~43~~, wherein

permanent magnets are disposed in at least the first flux barriers or the second flux barriers.

~~86~~. A rotor of a synchronous reluctance motor equipped with a stator core including an armature winding, comprising:

a rotor shaft which is supported in a rotatable manner and axially extends at a rotation axis; and

a rotor core shaped in a cylindrical form including a bridge portion on an outer peripheral portion thereof, on which a plurality of flux barriers are formed and which is disposed at outer circumference of the rotor shaft and fixed to the rotor shaft and extends in the direction of the rotation axis, wherein

the flux barriers include

a plurality of first flux barriers which are formed in such a way as to be spaced out in the circumferential direction each other and extend in a radial direction, and

a plurality of second flux barriers which are formed in each of circumferential angular regions sandwiched between the first flux barriers in such a way as to form a curved surface convex toward the rotation-axis center and to spread and be spaced out in the circumferential direction ~~each other~~,

the rotor shaft includes a plurality of radial plates which are made of nonmagnetic material and spaced out in the

circumferential direction and which extend toward a radial-direction outer side and extend in the direction of the rotation-axis and disposed in the first flux barriers and,

projections are formed at least in one of the rotor core and the radial plates and grooves are formed in another for mutual fitting.