[0017] FIG. **1** depicts a longitudinal cross sectional view of a reduced reaction alternating current generator according to an exemplary embodiment of the present invention;

[0018] FIG. **2** depicts an end cross sectional view of a reduced reaction alternating current generator according to an exemplary embodiment of the present invention;

[0019] FIG. **3** depicts a center cross sectional view of a reduced reaction alternating current generator according to an exemplary embodiment of the present invention;

[0020] FIG. **4** depicts a longitudinal cross sectional view of the flow of magnetic fields emanating from the first set of magnets within a reduced reaction generator according to an exemplary embodiment of the present invention;

[0021] FIGS. **5** and **6** depict the interaction between the magnetic flux originating from the north poles of the first set of magnets and the magnetic flux resulting from an induced current in the conductor winding according to an exemplary embodiment of the present invention;

[0022] FIG. **7** depicts a longitudinal cross sectional view of the flow of magnetic fields emanating from the second set of magnets within a reduced reaction generator accordance to an exemplary embodiment of the present invention; and

[0023] FIGS. **8** and **9** depict the interaction between the magnetic flux originating from the south poles of the second set of magnets and the magnetic flux resulting from an induced current in the conductor winding according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0024] The present invention relates to a reduced reaction rotating alternating current generator providing improvement in efficiency characteristics not currently available in standard alternating current generators.

[0025] FIG. **1** depicts a longitudinal cross sectional view of a reduced reaction alternating current generator according to an exemplary embodiment of the present invention. As shown by FIG. **1**, the induction machine **100** comprises a shaft **101**, a rotor **102**, a stator **103**, a first set of magnets **104**, a second set of magnets **105** (not shown), a conductor winding **106** and silicon steel pieces **107**.

[0026] The rotor **102** is a cylinder of high permeability magnetic material attached directly to the shaft **101** using any conventional known method that provides for a secure and permanent bonding under normal operating conditions. The rotor **102** is sized to be fully encompassed within the stator **103** while the shaft **101** is sized to extend beyond at least one end of the stator **103**.

[0027] The shaft **101** is mounted within the stator **103** so as to allow the shaft **101** and the attached rotor **102** to rotate freely within the stator **103** when the shaft **101** is driven by an external drive source. The external drive source is coupled to one end of the shaft **101** that extends beyond the stator **103**. The external drive source may be driven either at a variable speed or at a synchronous speed. As such the drive source may be an alternating current (AC) based source or a direct current (DC) based source. The drive source may also be a non-electric based drive source such as a hydro, wind or an internal combustion based source. The means of coupling the drive source to the shaft **101** will be dependent on the type drive source and any conventional know means appropriate to the drive source type may be implemented.

[0028] In an exemplary embodiment, the shaft is two 30 mm diameter 1018 steel, the rotor is 370 mm diameter 1018 steel and the stator has a 570 mm diameter.

[0029] Provisions are made on the cylindrical surface of the rotor **102** for the mounting of the first set magnets **104** and for the mounting of the second set of magnets **105** near each of the ends of the rotor **102**. Provisions are also made for the mounting of the silicon steel pieces **107** on the rotor at positions near the center of the rotor.

[0030] The first set of magnets **104** and the second set of magnets **105** (not shown) are attached to the ends of the rotor **102** cylinder using any conventionally method known to provide for a secure and permanent bonding under normal operating conditions. Each end of the rotor **102** contains one of the first set of magnets **104** and one of the second set of magnets **105**, for a total of four magnets. The first set of magnets **104** are oriented with their north poles facing the stator **103** and their south poles coupled to the rotor **102**. The second set of magnets **105** (not shown) are oriented with their south poles facing the stator **103** and their north poles coupled to the rotor **102**. The magnets may be permanent magnets or electromagnets.

[0031] In an exemplary embodiment, the permanent magnets are Neodymium magnets with a maximum energy product (BH_{max}) of 48 to 50 MGOe. Moreover, in another exemplary embodiment the electromagnets are radial pole and are attached to the rotor in a manner generally known in the industry.

[0032] The silicon steel pieces **107** are also attached to the rotor **102** using any conventionally method known to provide for a secure and permanent bonding under normal operating conditions. There is a single silicon steel piece **107** corresponding to each magnet of the first and second sets of magnets **104** attached to the rotor **102**. Each silicon steel piece **107** is positioned in line with its corresponding magnet leaving a predefined distance **109** between silicon steel piece and its corresponding magnet. Each silicon steel piece **107** is comprised of silicon steel which is a specialty steel tailored to have a small magnetic hysteresis area and high magnetic permeability. A high magnetic permeability is defined as having a magnetic saturation level above 1.8 Teslas.

[0033] In an exemplary embodiment, the first and second sets of magnets **104**, **105** and the silicon steel pieces **107** are each sized to have approximately the same surface area and the distance **109** between silicon steel piece and a corresponding magnet is no more than the length of the magnet in the axial plane.

[0034] The rotor **102** and the attached magnets **104**, **105** and steel pieces **107** are each sized as to provide for an air-gap **108** of a predefined size between the outer surfaces of the attached magnets **104**, **105** and silicon steel pieces **107** and the inner surface of the stator **103**. The air gap is sized to provide for the free rotation of the rotor **102** and the attached first and second sets of magnets **104**, **105** within the stator **103** as well as the efficient flow of magnetic flux into and out of the stator **103** across the air-gap **108**.

[0035] In an exemplary embodiment, the air-gap **108** is within a range of 3 mm to 10 mm.

[0036] The stator **103** is composed of longitudinally placed silicon steel laminates having grains oriented along the path of the magnetic flux that enters and exits the stator **103**. The stator **103** also includes longitudinally oriented slots in which the conductor winding **106** is laid, the conductor winding **106** positioned such as to be cut through by the rotating magnetic flux originating from the first and second sets of magnets **104** attached to the rotating motor **102**.