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ROTATING ELECTRIC MACHINE



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FIELD OF THE INVENTION

5 This invention relates to rotating electric machines. In particular, it relates to a hybrid permanent magnet motor and electric power generation apparatus.

BACKGROUND OF THE INVENTION

10 Rotating electric machines such as DC motors have been used for providing kinetic energy for various applications such as machines, vehicles and household appliances, etc. Attempts have been made to improve the efficiencies of the motor. Devices combining motor and power generators have also been developed to utilize the generated power for various purposes.

15 US Patent 5,258,697 discloses a permanent magnet electric motor that includes a rotor with a plurality of permanent magnets; a stator with a plurality of electromagnets and a controller coupled to the electromagnets to energize them. In operation, one set of electromagnets is energized primarily to negate their backward attraction to the respective set of permanent magnets that are moving away from the electromagnets. Torque is obtained by the magnetic attraction of
20 the other set of permanent magnets toward the core of the other set of the electromagnets.

 Since electromagnets are powered to negate the backward attraction force, these types of motors have a lower efficiency and higher power consumption.

25 US Patent 5,574,340 discloses a combined electromagnetically powered first motor and an electrically powered second motor both being powered by a primary power source. The first motor has at least one stationary electromagnet for driving, when energized, at least one permanent magnet on the rotor and for producing, when de-energized, a secondary electrical energy. The second motor is electrically coupled to the first motor for receiving the secondary electrical energy
30 from the electromagnets to enhance rotational speed and torque output power.

 US Patent 5,514,923 discloses a DC motor with generator and flywheel characteristics. The motor comprises a rotor having a plurality of permanent magnets, a stator having a plurality of windings energized by a rechargeable power pack. The motor is operable simultaneously in a
35 motor-mode, a generator mode and a flywheel-mode. When energized, the windings repel the respective permanent magnets to cause the rotor to rotate (motor-mode). When de-energized, the

windings generate electric power when the respective permanent magnets pass over. Such electric power can be stored and charged back to the rechargeable power pack, through a control system comprising a generated current sensor, a current consumption sensor, a rotor position sensor and a microprocessor.

In the above patents 5,574,340 and 5,514,923, individual permanent magnets are mounted separately on the rotor disc, therefore the areas between the magnets on the rotor disc are left without full magnetic coverage. The interactive force between the electromagnets and the permanent magnets, which rotates the rotor, is therefore limited due to the structural constraint of the permanent magnet arrangement. Since the interactive forces between the electromagnets and the individual permanent magnets are substantially the same, attractive or repulsive forces generated contrary to the direction of rotation must be avoided by using a complicated control system.

Additionally, because the same group of windings are alternately used as a magnetic force generating means and an electric power generating means, the control system for both energizing / de-energizing the windings and collecting generated electric power may become overly complex, resulting in reduced reliability.

SUMMARY OF THE INVENTION

According to one embodiment of the present invention, a rotating electric machine is provided. The machine comprises a stator, a rotor and preferably a vacuum chamber for housing the rotor such that the rotor is rotatable in the vacuum chamber. The stator includes a first group of windings, and the rotor includes a first corresponding permanent magnet associated with the at least one group of winding.

A rotating electric machine according to the present invention may be configured to work as an electric motor or an electric power generator, or both. When worked as an electric motor, the first group of windings is energizable to become electromagnet(s) and interact with the corresponding permanent magnet. The rotor is therefore rotatable by these interactive actions. When worked as an electric power generator, the rotor rotates so that the interaction between the permanent magnet and the windings generates electricity. In either mode, the rotor is rotatable in the vacuum chamber therefore the magnetic interactions between the winding and the permanent magnet can be improved.

Accordingly in a first aspect the present invention may broadly be the to further comprise a power source for selectively energizing the first group of windings. The rotor has an axis of rotation and a first permanent magnet is a permanent magnet disc including a first end surface adjacent to and facing the first group of windings; the axis of rotation passing perpendicularly through the center of the permanent magnet disc, the first end surface including a magnetic N-pole and an oppositely S-pole region spaced diametrically apart from each other across the axis of rotation, such that the N-pole region and the S-pole region pass sequentially over the windings with rotation of the rotor about the axis of rotation, wherein for each the N-pole region and S-pole region, at least one of the radial width of the region and the degree of magnetism of the region vary along the circumferential length of the region, the magnetic field of each N-pole or S-pole peaking closer to one end than the other.

Preferably, the radial width is greater toward one end than the other.

Alternatively, the degree of magnetism is higher toward one end than the other.

Preferably, the N-pole and the S-pole regions are substantially the same shape.

Preferably, the N-pole and the S-pole regions cover the full area of the first end surface of the permanent magnet disc and more preferably, the N-pole and the S-pole regions each covers substantially half of the full area of the first end surface of the permanent magnet disc.

Preferably, the first group of windings further comprises a first pair of windings, connected in series so as to be opposite polarity when energized, and the rotating electric machine further comprises a first circuit connecting the first pair of windings to the power source through a controller.

Preferably, the stator includes a second group of windings and the rotor further comprises a second permanent magnet associated with the second group of windings for generating electric power.

Preferably, the stator further comprises of a plurality of groups of electrically energizable windings and the rotor further comprises a plurality of permanent magnet discs associated with the corresponding windings for affecting the rotational motion of the rotating electric machine.

According to a second aspect of the present invention, there is disclosed a rotating electric machine comprising a stator having a group of coils; a rotor having at least one permanent magnet associated with the group of coils for generating electric power when the rotor is rotating. Preferably, the group of coils is placed inside the vacuum chamber. Alternatively, the group of coils may be placed outside the vacuum chamber.

This invention may also be the broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of the parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

A rotating electric machine according to the present invention may generate effective power output with reduced power consumption and simplified yet reliable controlling system for providing an improved power source for use in various applications.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partial side elevation in cross section of the rotating electric machine according to a first embodiment of the present invention,

Fig. 2 is a perspective view of the first permanent magnetic disc of Fig. 1 showing the different magnetic zones according to the present invention,

Fig. 3 is a perspective view of the first permanent magnetic disc of Fig. 1 showing the magnetic field strength distribution according to the present invention,

Fig. 4 is a block diagram showing the control circuit according to a first embodiment of the present invention,

Figs. 5A – 5F shows relative positions between the first permanent magnet disc and the first group of windings and the corresponding positions of the distribution disc in different moments of a rotation cycle according to the first embodiment of the present invention,

Fig. 6 shows a block diagram of an alternative configuration of the control circuit according to Fig. 3,

Figs. 7A – 7F shows various alternative configurations of the permanent magnet disc pattern and the first group of windings according to the present invention,

Fig. 8 is a partial side elevation in cross section of the rotating electric machine with a generator assembly according to a first embodiment of the present invention as shown in Fig. 1,

Fig. 9 is a partial side elevation in cross section of the rotating electric machine according to a second embodiment of the present invention,

Fig. 10 is a partially cross-sectional bottom view of Fig. 8 showing a first alternative configuration of the electric generation winding,

Fig. 11 is a partially cross-sectional bottom view of Fig. 8 showing a second alternative configuration of the electric generation winding,

Fig. 12 a partially cross-sectional top view of the distribution disc showing the positions have the first and the second actuators when the distribution disc is stationary,

Fig. 13 is a partially cross-sectional top view of the distribution disc showing the early activation of the switch by the first actuator when the distribution disc is rotating, and

Fig. 14 is a partially cross-sectional top view of the distribution disc showing the early deactivation of the switch by the second actuator when the distributor disc is rotating.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A rotating electric machine according to the present invention may be configured to work as an electric motor or an electric power generator, or both. When worked as an electric motor, a first group of windings is energizable to become electromagnet(s) and interact with a corresponding permanent magnet. The permanent magnet, which is coupled to a rotor, is therefore rotatable by this interactive action. The present invention may be used both as a motor and an electric power generator. When used as a generator, the rotor rotates so that the interaction between the permanent magnet and the windings generates electricity. In either mode, the rotor is rotatable in the vacuum chamber therefore the magnetic interactions between the winding and the permanent magnet can be improved.

Fig. 1 shows a rotating electric machine according to a first embodiment of the present invention. The rotating electric machine comprises primarily a stator, a power source and a rotor.

The rotor comprises a shaft 10, a first permanent magnet which is a disc 20 mounted on the shaft 10 through a support disc 30. The support disc 30 is made of non-magnetic material, such as copper. The rotor shaft 10 is supported by bearings 12 and 14. The bearings 12 and 14 may be any appropriate type of bearing such as normal ball bearings, magnetic bearings, hydrodynamic bearings or aerodynamic bearings. At one end of the shaft 10 there is mounted a distribution disc or commutator 50. Carried by the rotor, the first permanent magnet disc 20 is rotatable along a first circumferential direction 200 about its axis of rotation 16 (Fig. 2).

The stator comprises of a housing 90, a housing cover 100, a first group of windings with six windings 110A, 110B, 120A, 120B, 130A and 130B (only two windings 110A and 110B are shown) and a disc reader 60. The distribution disc 50 and the disc reader 60 forms a position controller, the function and construction of which shall be described in detailed later. The first group of six windings 110A, 110B, 120A, 120B, 130A and 130B are positioned in the housing cover 100 and adjacent to the permanent magnet disc 20, leaving a gap 102 therebetween. The first group of six windings 110A, 110B, 120A, 120B, 130A and 130B are selectively energizable by a power source 80. When energized, the windings 110A, 110B, 120A, 120B, 130A and 130B serve as electromagnets.

The first permanent magnet disc 20 comprises a first end face 22, which faces the first group of windings 110A, 110B, 120A, 120B, 130A and 130B. The first end face 22 is comprised of an N-pole and an S-pole, as shown in Fig. 2. The N-pole and the S-pole are spaced diametrically apart from each other about the axis of rotation 16. Accordingly, the N-pole and the S-pole are rotatable with respect to the axis of rotation 16 along a first direction of rotation 200.

Referring to Fig 2, the N-pole and the S-pole are shaped with a circular head and an end that tapers along the circumference of the permanent magnetic disc 20 in the first direction of rotation 200. The N-pole and S-pole regions each consist of three zones 312, 314, 316 and 322, 324, and 326 respectively and collectively referred to as the N-pole zone (or region) 401 and the S-pole zone (or region) 402. The line 400 shows the separation between the N-pole zone 401 and S-pole zone 402. In a preferred configuration, the N-pole and the S-pole are substantially the same size and shape and cover the full area of the first end face 22 of the permanent magnet disc 20. The centers 322A and 312A of the two zones 322 and 312 are located at the mid points of the radius of the first end face 22. The first permanent magnet disc 20 is rotatable around axis 16 in the first direction of rotation 200.

Referring to Fig. 3, the direction of the magnetic field 403 is perpendicular to the first end face 22. The magnetic field strength of the N-pole zone 401 and S-pole zone 402 is proportional to their surface area and/or the degree of magnetism around a specific point. Therefore, the points of strongest magnetism are located at a point 312A located in zone 312 of the N-pole region 401 and at a point 322A located in zone 322 of S-pole region 402. The strength of the magnetic field 403 is weaker at the edges of the N-pole and S-pole zones 401 and 402 than at the point's 322A and 312A. Therefore, moving along clockwise along the circumferential length 412 of the N-pole region 401 and the S-pole region 402, the strength of the magnetic field decreases as the radial width 422 (and therefore, surface area of the zone around a specific point) of the N-pole region

401 and S-pole region 402 decrease. Therefore, a first end 401A, 402A of each of the N-pole region 401 and S-pole region 402 possess a degree of magnetism stronger than a second end 401B, 402B. The regions 312, 314, 316, 322, 324, and 326 (refer to Fig 2) can be further illustrated by their respective magnetic strengths H312, H314, H316, H322, H324, and H326. The magnetic field strengths of all the zones are configured in the following fashion: $H312 > H314 > H316$ and $H322 > H324 > H326$.

Reference is now made to Fig. 4. The first group of six windings 110A, 110B, 120A, 120B, 130A and 130B are electrically connected in pairs 110A and 110B, 120A and 120B, 130A and 130B. The disc reader is comprised of three switches 310, 320 and 330, which will be turned "OFF" when the distribution disc 50 passes therethrough, and will be turned "ON" to the contrary. The distributor disc 50 comprises a first trigger 52 for turning the switches 310, 320 and 330 from an "OFF" state to an "ON" state, and a second trigger 54 for turning the switches 310, 320 and 330 from an "ON" state into an "OFF" state. The first trigger 52 and the second trigger 54 are positioned 120-degrees apart. The distribution disc 50 is mounted on the same axis 16 with the first permanent magnet disc 20 and both follow the same direction of rotation 200. The switches 310, 320, and 330 may be mechanically controlled, light sensing, or any other type of switch that is triggerable between an "OFF" and "ON" state by the distribution disk 50.

A first circuit 210 connects the power source 80, the first pair of windings 110A, 110B and the first switch 310 in series. Likewise, a second circuit 220 connects the power source 80, the second pair of windings 120A, 120B and the second switch 320 in series; a third circuit 230 connects the power source 80, the third pairs of windings 130A, 130B and the third sensor 330 in series.

The first pair of windings 110A, 110B are wound so when energized, the winding 110A becomes an electromagnet with its N-pole facing the primary N-zone 312 of the first permanent magnet disc 20 at the center point 312A, and winding 110B becomes an electromagnet with its S-pole facing the primary S-zone 322 of the first permanent magnet disc 20 at the center point 322A.

As the first pair of windings 110A, 110B are respectively aligned with the center points 312A, 322A of the N-pole and the S-pole at the time of start, repulsive forces between the winding 110A and the primary N-pole zone 312, and the winding 110B and the primary S-pole zone 322 will be in the direction substantially perpendicular to the first surface of the first permanent magnet disc 20 therefore it will not cause the permanent magnet disc 20 to rotate. The magnetic strength of both the N-pole zones 312, 314, 316 and the S-pole zones 322, 324, 326 are unevenly

distributed, thus repulsive forces will be generated between the winding 110A and the secondary N-zones 314, 316, and the winding 110B and secondary S-zones 324, 326. These forces drive the permanent magnet disc 20 to rotate in the direction of rotation 200

5 Immediately after the start of rotation of the permanent magnet disc 20, the first pair of windings 110A, 110B become un-aligned with respect to the primary N-zone 312 and the primary S-zone 322. Stronger repulsive forces will be generated between the winding 110A and the primary N-pole zone 312, and winding 110B and the primary S-pole zone 322, which will accelerate the rotation of the permanent magnet disc 20.

10 Reference is now made to Fig. 5. The first pair of windings 110A and 110B remains energized until the permanent magnet disc 20 rotates clockwise to the 120-degree position from the starting position, the 0-degree position. During this period, as shown in position 5B, one sample position between 0 and 120-degrees, rotation of the permanent magnet disc 20 is effected
15 by the repulsive forces between the winding 110A and N-pole zone 401, winding 110B and S-pole zone 402, and the simultaneous attractive forces between the winding 110A and the S-pole zone 402, winding 110B and the N-pole zone 401. Although the permanent magnet disc 20 in this embodiment of the present invention rotates clockwise, one of skill in the art may reorient the magnet disc and corresponding windings to rotate anti-clockwise.

20 Upon reaching position 5C, the 120-degree position, the second trigger 54 turns off the first switch 310 whereby opening the first circuit 210 and simultaneously, the first trigger 52 turns on the second switch 320 to close the second circuit 220, refer to Fig. 4. The first pairs of windings 110A, 110B are de-energized and the second pair of windings 120A, 120B are energized.
25 Subsequently, magnetic interaction occurs between the second pair of windings 120A, 120B and the N-pole and S-pole zones 401 and 402 of the permanent magnet disc 20 as in the same manner as illustrated above, which drives and accelerates the permanent magnet disc 20 to rotate continuously.

30 When the permanent magnet disc 20 reaches position 5E, the 240-degree position, the second switch 320 is deactivated and opens the second circuit 220. The third switch 330 is activated and closes the third circuit 230. The magnetic forces generated between the third pair of windings 130A, 130B and the N-pole and the S-pole zones 401 and 402, cause the permanent magnet disc 20 rotate continuously. A rotation cycle is completed once the permanent magnet disc
35 20 and the distribution disc 50 returns to the 0-degree position, refer to Fig. 5A. The permanent magnet disc 20 combined with other parts of the rotor have a certain mass, this results in an inertia

momentum which assists the rotation of the permanent magnet disc 20. The above operation cycle is repeated so that the permanent magnet disc 20 rotates continuously.

Fig. 6 shows a single-phase rotating electric machine. It is comprised of one pair of windings 110A, 110B, a power source 80, a first switch 310 and associated distribution disc 50. The operation of this circuit is similar to that described in Fig. 4, only simpler. Specifically there is one circuit with one set of control mechanisms as opposed to three in Fig. 4.

Fig. 7A-7F shows alternate configurations of the N-pole and S-pole zones 401 and 402 of the permanent magnet disc 20 and the first group of windings 110A, 110B, 120A, 120B, 130A and 130B.

Fig. 7A shows a configuration having a different number and shape of the first group of windings 110A, 110B, 120A, 120B, 130A and 130B. In particular the number of windings has increased from six to ten and their shape has been modified to resemble a polygon 405A-405J. The N-pole and S-pole zones 401 and 402 on the permanent magnet disc 20 remain the same.

Fig. 7B shows the N-pole and S-pole zones 401 and 402 towards the outer edge of the permanent magnet disc 20. This leaves the center of the permanent magnet disc 20 with an unmagnetized region. The two zones 401 and 402 cover substantially less than the full area of the first end face 22 of the permanent magnet disc 20.

Fig. 7C shows the N-pole and S-pole zones 401 and 402 towards the center of rotation of the permanent magnet disc 20, leaving the absolute center and outer edges of the permanent magnet disc 20 in an unmagnetized state. The two zones 401 and 402 cover substantially less than the full area of the first end face 22 of the permanent magnet disc 20.

Fig. 7D shows the N-pole and S-pole zones 401 and 402 towards the outer edge of the permanent magnet disc 20 but with the tapering end of each zone 401 and 402 following the axis of rotation of the centers of the windings 110A, 110B, 120A, 120B, 130A and 130B. The two zones 401 and 402 cover substantially less than the full area of the first end face 22 of the permanent magnet disc 20.

Fig. 7E shows the N-pole and S-pole zones 401, 402 as acute regions with the outer edge of the regions 401 and 402 following the edge of the permanent magnet disc 20. The two zones 401 and 402 cover substantially less than the full area of the first end face 22 of the permanent

magnet disc 20 The degree of magnetism on regions 401 and 402 vary along the direction 200, and in a preferred example, the degree of magnetism is decreased from one end 401A to another end 401B, and from one end 402A to another end 402B, respectively. The degree of magnetism may be adjusted based on the strength of the magnet.

Fig. 7F shows two sets of N-pole and S-pole zones labelled 406A, 406B and 407A, 407B. These zones 406A, 406B, 407A and 407B are substantially the same size and shape as those discussed in Fig 7E. The degree of magnetism distribute in the similar way as that under Fig. 7E.

Figs. 8 and 9 show an alternative configuration to Fig 1. Each configuration has the addition of a generator (description follows) whereby the electricity generated may be directed back to the power source 80 for recharging purposes or other purposes.

Fig. 8 shows a rotating electric machine with a second permanent magnet disc 70 mounted on the rotor and a second group of windings 170 mounted on the stator. Rotating with the rotor, the second permanent magnetic disc 70 and the second group of windings 170 work as a generator. The electricity generated may be directed back to the power source for purposes such as recharging. The housing 90 and the housing cover 100 may be fixed together in an airtight manner to form an isolated chamber for containing the rotor assembly. The air in the isolated chamber may be exhausted so that a vacuum chamber 95 may be obtained. This minimizes the undesirable effect of air resistance on the rotor during rotation and improvement of magnetic interaction between the second permanent magnet disc 70 and the second group of windings 170.

In this configuration shown in Fig. 9, a single magnet disc 71 is used. The magnet disc 71 comprises an annular recess 72 for receiving the second group of windings 170. Magnetic interaction between the second permanent magnet disc 70 and the second group of windings 170 may be improved under this configuration.

Fig. 10 and 11 show alternative configurations for the second group of windings 170. They may be in the form of a plurality of windings 170A-170F as shown in Fig. 10, or a single winding 174 as shown in Fig. 11. These windings 170 and 174 may be placed inside the vacuum chamber 95 or alternatively, outside the vacuum chamber 95 to enable external cooling.

In the configuration shown in Fig 10, the group of windings 170 is in the form of a plurality of windings 170A-170F.

Fig. 11 shows the winding 174 taking on a single torus-shaped configuration.

Fig. 12 shows an alternative configuration of the distribution disc 50, which further comprises a first actuator 152 and a second actuator 252. The first actuator 152 is mounted onto the distribution disc 50 through a first pivot 154 and is rotatable thereabout between a first normal position 156 and an advance-activating position 158 (shown as dashed contour line 159). The second actuator is mounted onto the distribution disc 50 through a second pivot 254 and is rotatable thereabout between a second normal position 256 and an advance-deactivating position 258 (shown as dashed contour line 259). The first and the second normal positions are 120-degree apart. To correspond to this configuration, the first trigger 52 is positioned at the advance-activating position 158. Under this configuration, the first and second triggers 52 and 54 are positioned more than 120-degree apart.

When the rotor is not rotating (Fig. 12), the first actuator 152 is biased against a first normal position stopper 151 by a first resilient member (not shown). The second actuator is biased against a second normal position stopper 251 by a second resilient member (not shown). When rotated with the distribution disc 50 (Fig. 13), a first centrifugal force 157 will cause the first actuator 152 to rotate towards its advance-activation position stopper 153. The result of which will cause early activation of the first switch 310. This configuration may be useful for power sources, which requires certain lead-time from start before reaching the maximum level of power output.

Likewise, when rotated with the distribution disc 50 (Fig. 14), a second centrifugal force 257 will cause the second actuator 252 to rotate towards its advance-deactivation position stopper 253. The result of which will cause early deactivation of the first switch 310. This configuration may be useful for energy-saving purposes, as when the rotor rotates under a certain level of speed, the inertial momentum will contribute to the rotation of the rotor.

It should be appreciated that the configurations and structures of the rotating electric machine above are for illustrative purposes only. Variations and modifications may be made under the same inventive concept without departing from the following claims. For example, the N-pole and the S-pole of the first permanent magnet disc may be in a unique shape along the direction of rotation 200 (Fig. 7E and Fig. 7F), but with an unevenly arranged magnetic field strength distribution along the direction of rotation 200. The first group of windings may have more windings or in different shape, for example the windings 405A-405J shown in Fig. 7A.

CLAIMS

- 1 A rotating electric machine comprising:
 - 2 a stator having a first group of windings;
 - 5 a power source for selectively energizing the first group of windings; and
 - 3 a rotor having a first permanent magnet to be magnetically coupled with the first group of windings, wherein the rotor includes an axis of rotation that passes perpendicularly through the center of the first permanent magnet and wherein the rotor is to rotate the first permanent magnet about the axis of rotation.
- 10 2. The rotating electric machine of claim 1, wherein the first permanent magnet is a permanent magnet disc, wherein the permanent magnet disc includes a first end surface adjacent to and facing the first group of windings, the first end surface including a magnetic N-pole region and an oppositely magnetic S-pole region located diametrically
15 apart from each other across the axis of rotation such that the N-pole region and the S-pole region pass sequentially over the first group of windings with rotation of the rotor about the axis of rotation.
- 20 3. The rotating electric machine of claim 2, wherein for each of the N-pole region and S-pole region, at least one of a radial width of the region and a degree of magnetism of the region varies along a circumferential length of the region.
- 25 4. The rotating electric machine of claim 2, wherein the N-pole region and S-pole region includes a first end and a second end, wherein the degree of magnetism is higher towards a first end relative to a second end and wherein the radial width is greater towards the first end relative to the second end.
- 30 5. The rotating electric machine of claim 4, wherein the N-pole region and the S-pole region are substantially the same shape.
6. The rotating electric machine of claim 4, wherein the N-pole region and the S-pole region cover the full area of the first end surface of the permanent magnet disc.
- 35 7. The rotating electric machine of any one of claims 4, 5 or 6, wherein each of the N-pole region and the S-pole region covers substantially half of the full area of the first end surface of the permanent magnet disc.

8. The rotating electric machine of claim 2, wherein the first group of windings further comprises a first pair of windings, connected in series to be in opposite polarity when energised, and the rotating electric machine further comprises a first circuit connecting the first pair of windings to the power source through a controller.
9. The rotating electric machine of claim 8, wherein the controller further comprises:
at least one switch mounted on the stator; and
a distribution disc mounted on the rotor and rotatable theretogether relative to the at least one switch, the distribution disc having a first trigger for activating the at least one switch when the peak magnetic field of the N-pole region passes over one of the first pair of windings, and a second trigger for deactivating the at least one switch before the peak magnetic field of the N-pole region passes over the other one of the first pair of windings.
10. The rotating electric machine of claim 8, wherein the first trigger further comprises a first actuator, the first actuator being movable between a first normal position when the distribution disc is not rotating, and an advance-activating position when the distribution disc is rotating under a predetermined rotational speed for earlier activating the at least one switch.
11. The rotating electric machine of claim 8, wherein the second trigger further comprises a second actuator, the second actuator being movable between a second normal position when the distribution disc is not rotating, and an advance-deactivating position when the distribution disc is rotating under a predetermined rotational speed for earlier deactivating the at least one switch.
12. The rotating electric machine of claim 8, wherein the first group of windings further comprises a plurality of the pairs of windings and the rotating electric machine further comprises a plurality of corresponding circuits connecting the respective plurality pairs of windings to the power source through a plurality of switches of the controller.
13. The rotating electric machine of claim 1, wherein the first permanent magnet is rotatable relative to the first group of windings for generating electric power.

14. The rotating electric machine of claim 13, wherein the first group of windings are placed inside a vacuum chamber
15. The rotating electric machine of claim 13, wherein the first group of windings are placed outside the vacuum chamber.
16. The rotating electric machine of claim 13, further comprising a second permanent magnet to be magnetically coupled with a second group of windings, wherein the second permanent magnet includes a recess for receiving the second group of windings.
17. The rotating electric machine of claim 11, wherein the plurality of the pairs of windings are positioned around the circumference of the permanent magnetic disc along the direction of rotation.
18. The rotating electric machine of claim 2, wherein the stator further comprises of a plurality of groups of electrically energizable windings and the rotor further comprises a plurality of permanent magnet discs to be magnetically coupled with the corresponding windings for affecting the rotational motion of the rotating electric machine.
19. A rotating electric machine of claim 1,
wherein the degree of magnetism of the each the N-pole region and S-pole region substantially decreases along their circumferential length, the magnetic field peaks closer to a first end than a second end of each of the N-pole region and S-pole region.
20. The rotating electric machine of claim 19, wherein the radial width of the N-pole region and the S-pole region decreases along their circumferential length.
21. The rotating electric machine of claim 19, wherein the N-pole region and the S-pole region each covers substantially half of the full area of the first end surface of the permanent magnet disc.
22. A rotating electric machine, comprising:
a stator having a first group of windings;
a power source for selectively energizing the first group of windings; and

a rotor having a first permanent magnet to be magnetically coupled with the first group of windings, wherein the first permanent magnet is a permanent magnet disc having a first end surface including a magnetic N-pole region and an oppositely magnetic S-pole region; and
5 a vacuum chamber for housing the rotor.

23. A rotating electric machine of claim 22, wherein the permanent magnet disc has an axis of rotation that passes through the center of the permanent magnet disc and wherein the magnetic N-pole region and the magnetic S-pole region are spaced diametrically apart
10 from each other across the axis of rotation such that the N-pole region and the S-pole region pass sequentially over the first group of windings with rotation of the rotor about the axis of rotation.

24. A rotating electric machine of claim 23, further comprising a second group of windings wherein the second group of windings is to generate electric power with the rotation of the rotor.
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25. A rotating electric machine of claim 24, wherein the second group of windings is magnetically coupled to the first permanent magnet.
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26. A rotating electric machine of claim 24, wherein the second group of windings is magnetically coupled to a second permanent magnet, wherein the second permanent magnet is separated from the first permanent magnet.

27. The rotating electric machine of claim 23, wherein for each the N-pole region and S-pole region, at least one of a radial width of the region and a degree of magnetism of the region vary along a circumferential length of the region.
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28. The rotating electric machine of claim 23, wherein each of the N-pole region and S-pole region includes a first end and a second end, wherein the degree of magnetism is higher towards the first end relative to the second end and wherein the radial width is greater towards the first end relative to the second end.
30