Claims

1. A flux machine comprising:

a stator;

a plurality of rotors configured to rotate in a rotary direction about a central axis of the plurality of rotors, the plurality of rotors including a first rotor and a second rotor configured to rotate independently from one another about the central axis in the rotary direction;

a plurality of coil assemblies coupled to the stator, each of the plurality of coil assemblies being oriented such that current within the plurality of coil assemblies generally flows in a plane perpendicular to the rotary direction; and

a plurality of magnet sets coupled to the plurality of rotors, each of the plurality of magnets sets including a first magnet coupled to the first rotor and a second magnet coupled to the second rotor, the first magnet of each of the plurality of magnet sets being configured to direct magnetic flux in a first direction toward a first side of a corresponding one of the plurality of coil assemblies, the second magnet of each of the plurality of magnet sets being configured to direct magnetic flux in a second direction toward a second side of the corresponding one of the plurality of coil assemblies,

wherein the first rotor includes a first axle configured to rotate about the central axis and the second rotor includes a second axle configured to rotate about the central axis such that the first magnet of each of the plurality of magnet sets is configured to move relative to the second magnet of each of the plurality of magnet sets when electrical current is present in one or more of the plurality of coil assemblies.

2. The flux machine of claim 1, wherein the first magnet and the second magnet of each of the plurality of magnet sets are permanent magnets, electromagnets, or a combination of permanent magnets and electromagnets.

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3. The flux machine of claim 1, wherein each of the plurality of coil assemblies have side edges and the first magnet and the second magnet of each of the plurality of magnets sets are configured to conform to the side edges of the corresponding one of the plurality of coil assemblies, and wherein gaps between the corresponding one of the plurality of coil assemblies and the first magnet and the second magnet are minimized.

4. The flux machine of claim 1, wherein both the first magnet and the second magnet direct magnetic flux orthogonal to the rotary direction.

5. The flux machine of claim 1, wherein the first direction is generally perpendicular to the second direction, and wherein the first direction is axial and the second direction is radial.

6. The flux machine of claim 1, wherein the first direction is generally parallel to and opposed to the second direction, and wherein the first direction and second direction are (i) both axial, or (ii) both radial.

7. The flux machine of claim 1, wherein each of the plurality of coil assemblies are rectangular or near rectangular.

8. The flux machine of claim 1, wherein magnetic flux of each of the plurality of magnet sets is configured to be directed perpendicularly to the plane of the current flowing in a corresponding coil assembly.

9. The flux machine of claim 1, wherein the first rotor includes a third magnet and a fourth magnet.

10. The flux machine of claim 1, further comprising a third rotor, and wherein each of the plurality of magnet sets further includes a third magnet and a fourth magnet, the third magnet being coupled to the first rotor and configured to direct magnetic flux toward the corresponding one of

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the plurality of coil assemblies in a third direction, the third direction being generally parallel to and opposed to the first direction, the fourth magnet being coupled to the third rotor, such that each of the plurality of coil assemblies on the stator is surrounded by the first magnet, the second magnet, the third magnet, and the fourth magnet of one of the plurality of magnet sets.

11. The flux machine of claim 10, wherein the third rotor includes a third axle, and wherein each of the first axle, the second axle, and the third axle are configured to rotate independently of each of the other axles.

12. The flux machine of claim 11, wherein one or more of the first rotor, the second rotor, or the third rotor is configured to function as a generator simultaneously as one or more of the other rotors functions as a motor.

13. The flux machine of claim 1, wherein each of the plurality of coil assemblies includes an electrical coil disposed within channels of a permeable core.

14. The flux machine of claim 1, wherein each of the plurality of magnets sets further includes a third magnet coupled to the first rotor and a fourth magnet coupled to the second rotor.

15. The flux machine of claim 1, further comprising a third rotor, wherein each of the plurality of magnet sets further includes a third magnet coupled to the first rotor, a fourth magnet coupled to the first rotor, and a fifth magnet coupled to the third rotor.

16. The flux machine of claim 15, wherein the third magnet is configured to direct magnet flux in a third direction, the third direction being generally perpendicular to the first direction and generally parallel to and opposed to the second direction.

17. The flux machine of claim 14, wherein the fourth magnet and the fifth magnet are each configured to direct magnetic flux in a fourth direction, the fourth direction being generally

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perpendicular to the second direction and the third direction and generally parallel to and opposed to the first direction.

18. The flux machine of claim 1, further comprising a third rotor and a fourth rotor, wherein each of the plurality of magnet sets further includes a third magnet coupled to the fourth rotor and a fourth magnet coupled to the fourth rotor.

19. The flux machine of claim 18, wherein each of the plurality of magnet sets includes a fourth magnet, and wherein the second magnet in each magnet set faces toward the corresponding one of the plurality of coil assemblies in a first axial direction, and the fourth magnet in each magnet set faces toward the corresponding one of the plurality of coil assemblies in a second axial direction opposing the first axial direction.

20. The flux machine of claim 1, wherein the second direction is generally perpendicular to the first direction.

21. The flux machine of claim 20, wherein the first direction is radial and the second direction is axial.

22. The flux machine of claim 1, wherein the second direction is generally parallel to and opposed to the first direction.

23. The flux machine of claim 22, wherein the first direction and the second direction are (i) both radial or (ii) both axial.

24. The flux machine of claim 1, wherein each of the plurality of coil assemblies includes a respective coil wound at least partially about a respective core stack.

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25. The flux machine of claim 24, wherein the respective coil each of the plurality of coil assemblies is wound at least partially about a first portion of the respective core stack, and wherein a second portion of the respective core stack is positioned between a side of the coil and a magnet from one of the plurality of magnet sets.

26. The flux machine of claim 1, wherein the first rotor and the second rotor are configured to rotate at an identical frequency.

27. The flux machine of claim 1, wherein the first rotor is configured to rotate at a first frequency and the second rotor is configured to rotate at a second frequency different than the first frequency.

28. The flux machine of claim 1, wherein each magnet in each of the plurality of magnet sets is configured to direct magnetic flux in an axial direction or a radial direction.

29. The flux machine of claim 1, wherein each of the plurality of magnet sets includes a third magnet, and wherein the first magnet in each magnet set faces toward the corresponding one of the plurality of coil assemblies in a first radial direction, and the third magnet in each magnet set faces toward the corresponding one of the plurality of coil assemblies in a second radial direction opposing the first radial direction.

30. A flux machine comprising:

a stator;

a plurality of rotors configured to rotate in a rotary direction about a central axis of the plurality of rotors, the plurality of rotors including a first rotor and a second rotor configured to rotate independently from one another about the central axis in the rotary direction;

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a plurality of coil assemblies coupled to the stator, each of the plurality of coil assemblies being oriented such that current within the plurality of coil assemblies generally flows in a plane perpendicular to the rotary direction; and

a plurality of magnet sets coupled to the plurality of rotors, each of the plurality of magnet sets including a first magnet coupled to the first rotor and a second magnet coupled to the second rotor, the first magnet being adjacent to a first side of a corresponding one of the plurality of coil assemblies and being configured to direct magnetic flux in a first direction toward the first side of the corresponding one of the plurality of coil assemblies, the second magnet being adjacent to the first side of the corresponding one of the plurality of coil assemblies and being configured to direct magnet flux in the first direction toward the first side the corresponding one of the plurality of coil,

wherein the first rotor includes a first axle configured to rotate about the central axis and the second rotor includes a second axle configured to rotate about the central axis such that the first magnet of each of the plurality of magnet sets is configured to move relative to the second magnet of each of the plurality of magnet sets when electrical current is present in one or more of the plurality of coil assemblies.

31. The flux machine of claim 30, wherein the first magnet and the second magnet of each of the plurality of magnet sets are permanent magnets, electromagnets, or a combination of permanent magnets and electromagnets.

32. The flux machine of claim 31, wherein each of the plurality of coil assemblies have side edges and the first magnet and the second magnet of each of the plurality of magnets sets are configured to conform to the side edges of the corresponding one of the plurality of coil assemblies, and wherein gaps between the corresponding one of the plurality of coil assemblies and the first magnet and the second magnet set is minimized.

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33. The flux machine of claim 30 wherein the magnetic flux of the first magnet and the second magnet is directed axially or radially.

34. The flux machine of claim 33 wherein the rotary motion is orthogonal to the magnetic flux of the first magnet and the second magnet.

35. The flux machine of claim 30, wherein each of the plurality of coil assemblies are rectangular or near rectangular.

36. The flux machine of claim 30, wherein magnetic flux of each of the plurality of magnet sets is configured to be directed perpendicularly to a plane of the current flowing in a corresponding coil assembly.

37. The flux machine of claim 30, wherein each of the plurality of coil assemblies includes an electrical coil disposed within channels of a permeable core.

38. A method comprising:

providing a flux machine, the flux machine including:

a stator;

a plurality of rotors, the plurality of rotors including a first rotor and a second rotor configured to rotate independently in a rotary direction about a central axis of the plurality of rotors;

a plurality coil assemblies coupled to the stator and;

a plurality of magnet sets coupled to the plurality of rotors, each of the plurality of magnet sets including a first magnet coupled to the first rotor and a second magnet coupled to the second rotor, the first rotor including a first axle configured to rotate about the central axis, the second rotor including a second axle configured to rotate about the central axis, the first magnet

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and the second magnet of each of the plurality of magnet sets being configured to direct magnet flux orthogonal to rotary direction;

electrically coupling the plurality of coil assemblies to an inlet current source to cause inlet current to flow through the plurality of coil assemblies, each of the plurality of coil assemblies being oriented such that the inlet current flowing through the plurality of coil assemblies generally flows in a plane perpendicular to the rotary direction; and

driving the first rotor externally to induce a supplementary current in the plurality of coil assemblies while the second rotor is simultaneously driven by at least the inlet current flowing through the plurality of coil assemblies, each of the plurality of coil assemblies being oriented such that the supplementary current in the plurality of coil assemblies generally flows in a plane perpendicular to the rotary direction.

39. The method of operating a flux machine of claim 38, wherein the first magnet and the second magnet of each of the plurality of magnet sets are permanent magnets, electromagnets, or a combination of permanent magnets and electromagnets.

40. The method of operating a flux machine of claim 38, wherein a gap between one of the plurality of coil assemblies and the first magnet and second magnet of a corresponding one of the plurality of magnet sets is minimized.

41. The method of operating a flux machine of claim 38, wherein the first axle and the second axle are coaxial.

42. The method of operating a flux machine of claim 38 wherein the frequencies at which the first and second rotors are driven with respect to each other is selected to influence the current flow in the stator coils such that harmonic contributions are minimized.

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43. The method of operating a flux machine of claim 38, wherein the first rotor is driven at a first frequency and the second rotor is driven at a second frequency, the first frequency being equal to the second frequency.

44. The method of operating a flux machine of claim 38, wherein the first magnet of each of the plurality of magnet sets is configured to direct magnet flux in an axial direction, and wherein the second magnet of each of the plurality of magnet sets is configured to direct magnet flux in a radial direction.

45. The method of claim 38, wherein each magnet in each of the plurality of magnet sets is configured to direct magnetic flux in an axial direction or a radial direction

46. A flux machine comprising:

a stator;

a plurality of rotors configured to rotate in a rotary direction about a central axis of the plurality of rotors, the plurality of rotors including a first rotor and a second rotor configured to rotate independently about the central axis in the rotary direction;

a plurality of coil assemblies coupled to the stator, each of the plurality of coil assemblies being oriented such that current within the plurality of coil assemblies generally flows in a plane perpendicular to the rotary direction, each of the plurality of coil assemblies having a first side, a second side, a third side, and a fourth side; and

a plurality of magnet sets coupled to the plurality of rotors, each of the plurality of magnet sets including (i) a first magnet and a second magnet coupled to the first rotor, and (ii) a third magnet and a fourth magnet coupled to the second rotor, the first magnet being configured to direct magnetic flux in a first axial direction toward the first side of a corresponding one of the plurality of coil assemblies, the second magnet being configured to direct magnetic flux in a first radial direction toward the second side of the corresponding one of the plurality of coil assemblies, the third magnet being configured to direct magnetic flux in a second axial direction opposing the

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first axial direction toward the third side of the corresponding one of the plurality of coil assemblies, the fourth magnet being configured to direct magnetic flux in a second radial direction opposing the first radial direction toward the fourth side of the corresponding one of the plurality of coil assemblies,

wherein the first rotor includes a first axle configured to rotate about the central axis and the second rotor includes a second axle configured to rotate about the central axis such that the first axial magnet and the second magnet of each of the plurality of magnet sets are configured to move relative to the third magnet and the fourth magnet of each of the plurality of magnet sets when electrical current is present in one or more of the plurality of coil assemblies,

wherein magnetic flux of each of the plurality of magnet sets is directed orthogonal to the rotary direction, and

wherein pole faces of the same polarity of the first magnet and the third magnet face toward each other and toward the corresponding one of the plurality of coil assemblies and pole faces of the same polarity of the second magnet and the fourth magnet face toward each other and toward the corresponding one of the plurality of coil assemblies.

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