Claims

1. A pump comprising:

a casing defining an interior volume;

a first gear disposed within the interior volume, the first gear having a first gear body and a plurality of first gear teeth;

a second gear disposed within the interior volume, the second gear having a second gear body and a plurality of second gear teeth projecting radially outwardly from the second gear body, the second gear is disposed such that a second face of at least one tooth of the plurality of second gear teeth aligns with a first face of at least one tooth of the plurality of first gear teeth;

a first variable-speed motor that rotates the first gear about a first axial centerline of the first gear in a first direction to transfer hydraulic fluid from an inlet of the pump to an outlet of the pump along a first flow path; and

a second variable-speed motor that rotates the second gear, independently of the first motor, about a second axial centerline of the second gear in a second direction to contact the second face with the first face and to transfer the hydraulic fluid from the inlet of the pump to the outlet of the pump along a second flow path, the contact sealing a fluid path from the outlet of the pump to the inlet of the pump such that a slip coefficient is at least one of 5% or less for a pump pressure in a range of 3000 psi to 5000 psi, 3% or less for a pump pressure in a range of 2000 psi to 3000 psi, 2% or less for a pump pressure in a range of 1000 psi to 2000 psi and 1% or less for a pump pressure in a range up to 1000 psi.

2. The pump of claim 1, wherein the first gear body includes a first cylindrical opening along the first axial centerline for accepting the first motor,

wherein the first motor is an outer-rotor motor and is disposed in the first cylindrical opening, the first motor comprising a first rotor, and

wherein the first rotor is coupled to the first gear to rotate the first gear about the first axial centerline in the first direction.

3. The pump of claim 1, wherein the first motor is an internal-rotor motor comprising a first rotor coupled to a first motor shaft such that the first motor shaft rotates with the first rotor, and

wherein the first motor shaft is coupled to the first gear to rotate the first gear about the first axial centerline in the first direction.

4. The pump of claim 2, wherein the second gear body includes a second cylindrical opening along the second axial centerline for accepting the second motor, and

wherein the second motor is an outer-rotor motor and is disposed in the second cylindrical opening, the second motor comprising a second rotor, and

wherein the second rotor is coupled to the second gear to rotate the second gear about the second axial centerline in the second direction.

5. The pump of claim 2, wherein the second motor is an internal-rotor motor comprising a second rotor coupled to a motor shaft such that the motor shaft rotates with the second rotor, and

wherein the motor shaft is coupled to the second gear to rotate the second gear about the second axial centerline in the second direction.

6. The pump of claim 5, wherein the second motor is disposed in the internal volume.

7. The pump of claim 5, wherein the second motor is disposed outside the casing.

8. The pump of claim 3, wherein the second motor is an internal-rotor motor comprising a second rotor coupled to a second motor shaft such that the second motor shaft rotates with the second rotor, and

wherein the second motor shaft is coupled to the second gear to rotate the second gear about the second axial centerline in the second direction.

9. The pump of claim 8, wherein the first motor and the second motor are disposed in the internal volume.

10. The pump of claim 8, wherein the first motor is disposed in the internal volume and the second motor is disposed outside the casing.

11. The pump of claim 8, wherein the first motor and the second motor are disposed outside the casing.

12. The pump of claim 1, wherein the second direction is opposite the first direction.

13. The pump of claim 1, wherein the second direction is same as the first direction.

14. The pump of claim 1, wherein the first flow path and the second flow path are same flow path.

15. The pump of claim 1, wherein the first flow path and the second flow path are different flow

paths.

16. A pump comprising:

a casing defining an interior volume;

a first fluid driver, the first fluid driver including,

a first fluid displacement member disposed within the interior volume and having a plurality of first projections, and

a first variable-speed prime mover disposed within the interior volume to rotate the first fluid displacement member about a first axial centerline of the first fluid displacement member in a first direction to transfer at least one of water and a hydraulic fluid from an inlet of the pump to an outlet of the pump along a first flow path; and

a second fluid driver, the second fluid driver including,

a second fluid displacement member disposed within the interior volume, the second fluid displacement member having at least one of a plurality of second projections and a plurality of indents, the second fluid displacement member is disposed such that a first surface of at least one of the plurality of first projections aligns with a second surface of at least one of the plurality of second projections or a third surface of at least one of the plurality of indents, and

a second variable-speed prime mover disposed within the interior volume to rotate the second fluid displacement member, independently of the first prime mover, about a second axial centerline of the second fluid displacement member in a second direction to contact the first surface with the corresponding second surface or third surface and to transfer the at least one of water and hydraulic fluid from the inlet of the pump to the outlet of the pump along a second flow path, the contact sealing a fluid path from the outlet of the pump to the inlet of the pump such that a slip coefficient is 5% or less.

17. The pump of claim 16, wherein the second direction is opposite the first direction.

18. The pump of claim 16, wherein the second direction is same as the first direction.

19. The pump of claim 16, wherein the first flow path and the second flow path are same flow path.

20. The pump of claim 16, wherein the first flow path and the second flow path are different flow paths.

21. The pump of claim 16, wherein the first prime mover and the second mover are bi-directional.

22. A method of transferring fluid from an inlet to an outlet of a pump having a casing to define an interior volume therein, and a first prime mover to drive a first fluid driver and a second prime mover to drive a second fluid driver, the method comprising:

rotatably driving the first prime mover to drive the first fluid driver in a first direction to perform the transfer of at least one of water and a hydraulic fluid;

simultaneously rotatably driving the second prime mover to drive the second fluid driver independently of the first fluid driver in a second direction to transfer at least one of water and a hydraulic fluid; and

synchronizing contact between the first fluid driver and the second fluid driver to seal a fluid path between the second port and the first port such that a slip coefficient is 5% or less,

wherein the first prime mover and the second prime mover are disposed within the interior volume, and

wherein the first prime mover and the second prime mover are variable speed.

23. The method of claim 22, wherein the second direction is opposite the first direction.

24. The method of claim 22, wherein the second direction is same as the first direction.

25. The method of claim 22, wherein the first and second fluid drivers are rotated in a range of 300 rpm to 900 rpm.

26. The method of claim 22, wherein the first prime mover and the second prime mover are disposed within the interior volume.

27. A method of transferring fluid from an inlet to an outlet of a pump having a casing to define an interior volume therein, and a first fluid driver and a second fluid driver, the method comprising:

rotatably driving the first fluid driver in a first direction to transfer hydraulic fluid;

simultaneously rotatably driving the second fluid driver independently of the first fluid driver in a second direction to transfer the hydraulic fluid; and

synchronizing contact between the first fluid driver and the second fluid driver such that a slip coefficient is at least one of 5% or less for a pump pressure in a range of 3000 psi to 5000 psi, 3% or less for a pump pressure in a range of 2000 psi to 3000 psi, 2% or less for a pump pressure in a range of 1000 psi to 2000 psi and 1% or less for a pump pressure in a range up to 1000 psi,

wherein the first prime mover and the second prime mover are variable speed.

28. The method of claim 27, wherein the second direction is opposite the first direction.

29. The method of claim 27, wherein the second direction is same as the first direction.

30. The method of claim 27, wherein the first and second fluid drivers are rotated in a range of 300 rpm to 900 rpm.