output to a single propeller. Furthermore it does not disclose how the speed of the propeller is controlled. This prior art system also does not provide means for the engines to supply power to the generators whilst both the engines and motors supply power to the propellers. Therefore, the battery may run out of energy to drive the motors. The system also does not provide flexibility in the propeller speed when the engine is run at full operational speed. Furthermore, no means are provided for increasing the propeller speed beyond the speed at which the motor and engines are providing maximum power to the propellers.

Summary

The present disclosure provides a propulsion system for providing a power output; said propulsion system comprising; a transmission configured to provide the power output; at least one first energy conversion machine; at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine; at least one second energy conversion machine operable to selectively drive or be driven by the transmission; ~~and~~ a power transfer arrangement for transferring power between the first and second energy conversion machines.

The present disclosure further provides a method of operating a propulsion system, said propulsion system comprising; a transmission configured to provide the power output; at least one first energy conversion machine; at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine; at least one second energy conversion machine operable to selectively drive or be driven by the

transmission; ~~and~~ a power transfer arrangement for transferring power between the first and second energy conversion machines; said method comprising; connecting the power unit to drive the transmission; or connecting the power unit to drive the at least one first energy conversion machine; or connecting the power unit to drive the transmission and the at least one first energy conversion machine.

The present disclosure further provides a marine vessel comprising a propulsion system for providing propulsion to the ship, said propulsion system comprising; a power unit providing a rotational output to a power unit output shaft; a first kinematic connection element attached to the power unit output shaft; and at least one planetary gearbox providing a rotational output to a transmission output shaft, said transmission output shaft being connected to a propulsion element; wherein the first kinematic connection element is operably connected to the at least one planetary gearbox.

The present disclosure further provides a propulsion system comprising; first and second power units; a transmission configured to transmit power to a transmission shaft; at least one first energy conversion machine; and a power unit transmission; wherein said power unit transmission comprises; a plurality of transmission shafts operably connecting the power unit transmission to the first and second power units, the transmission and the at least one first energy conversion machine; a first torque coupling for selectively operably connecting the second power unit to the power unit transmission; and a second torque coupling

CLAIMS:

1. A propulsion system for providing a power output; said propulsion system comprising;

a transmission configured to provide the power output;

at least one first energy conversion machine;

at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine;

at least one second energy conversion machine operable to selectively drive or be driven by the transmission; and

a power transfer arrangement for transferring power between the first and second energy conversion machines.

2. A propulsion system as claimed in claim 1 wherein the at least one first and second energy conversion machines are reversible hydraulic or electrical machines.

3. A propulsion system as claimed in claim 2 wherein the power transfer arrangement is hydraulic or electrical.

4. A propulsion system as claimed in any one of the preceding claims wherein the at least one power unit is operable to selectively drive the transmission via at least one drive shaft, at least one transmission coupling and at least one kinematic connection element.

5. A propulsion system as claimed in any one of the preceding claims wherein the at least one power unit is operable to selectively drive the at least one first energy conversion machine via at least one drive shaft and at least one kinematic connection element.

6. A propulsion system as claimed in claim 4 and claim 5 wherein the kinematic connection elements are gears, and the propulsion system comprises;

first and third gears mounted on a power unit output shaft;

a second gear interconnected with the first gear and providing a rotatable input to the transmission;

a fourth gear mounted on a first machine shaft and interconnected with the third gear, said first machine shaft providing an input or output to/from the at least one first energy conversion machine.

7. A propulsion system as claimed in any one of the preceding claims wherein the transmission comprises at least one planetary gearbox.

8. A propulsion system as claimed in claim 7 wherein the at least one planetary gearbox comprises a sun gear, a plurality of planetary gears attached to a carrier and a rotatable ring gear.

9. A propulsion system as claimed in claim 8 wherein the sun gear is rotatably connected to the at least one second energy conversion machine, the ring gear is rotatably connected to provide the power output and the carrier is operably connected to the at least one power unit.

10. A propulsion system as claimed in claim 6 and claim 9 wherein the carrier is rotatably connected to the second gear.

11. A propulsion system as claimed in claim 9 or claim 10 wherein the power output is provided by a rotatable transmission output shaft and the ring gear is rotatably connected to the transmission output shaft.

12. A work machine comprising at least one propulsion system of any one of claims 1 to 11.

13. A marine vessel comprising at least one propulsion system of any one of claims 1 to 11.

14. A method of operating a propulsion system, said propulsion system comprising;

a transmission configured to provide the power output;

at least one first energy conversion machine;

at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine;

at least one second energy conversion machine operable to selectively drive or be driven by the transmission; and

a power transfer arrangement for transferring power between the first and second energy conversion machines; said method comprising;

connecting the power unit to drive the transmission; or

connecting the power unit to drive the at least one first energy conversion machine; or

connecting the power unit to drive the transmission and the at least one first energy conversion machine.

15. A method as claimed in claim 14 comprising a first mode wherein power is transferred to the transmission via at

least one shaft, at least one kinematic connection element and at least one transmission coupling.

16. A method as claimed in claim 14 or claim 15 comprising a second mode wherein power is transferred via at least one shaft and at least one kinematic connection element to the at least one first energy conversion machine, said power being transferred from the at least one first energy conversion machine to the transmission via the power transfer arrangement and the second energy conversion machine.

17. A method as claimed in claim 15 and claim 16 comprising a third mode wherein power is transferred simultaneously in the first mode and the second mode.

18. A method as claimed in claim 15 to claim 17 comprising a fourth mode wherein power is transferred to the transmission in the first mode whilst power is transferred from the transmission to the second energy conversion machine.

19. A marine vessel comprising a propulsion system for providing propulsion to the ship, said propulsion system comprising;

a power unit providing a rotational output to a power unit output shaft;

a first kinematic connection element attached to the power unit output shaft; and

at least one planetary gearbox providing a rotational output to a transmission output shaft, said transmission output shaft being connected to a propulsion element;

wherein the first kinematic connection element is operably connected to the at least one planetary gearbox.

20. A marine vessel as claimed in claim 19 wherein the ship comprises a keel and the at least one planetary gearbox is located substantially within the keel.

21. A marine vessel as claimed in claim 19 or claim 20 further comprising a second kinematic connection element interlocked with the first kinematic connection element, the first kinematic connection element being operably connected to the at least one planetary gearbox via the second kinematic connection element.

22. A marine vessel as claimed in any one of claims 19 to 21 comprising multiple planetary gearboxes arranged in series.

23. A marine vessel as claimed in any one of claims 19 to 22 wherein the propulsion system comprises at least one first energy conversion machine operably connected to at least one second energy conversion machine, the power unit providing power to the at least one first energy conversion machine and the at least one second energy conversion machine being operably connected to the at least one planetary gearbox.

24. A propulsion system comprising;

first and second power units;

a transmission configured to transmit power to a transmission shaft;

at least one first energy conversion machine; and

a power unit transmission;

wherein said power unit transmission comprises;

a plurality of transmission shafts operably connecting the power unit transmission to the first and second power units, the transmission and the at least one first energy conversion machine;

a first torque coupling for selectively operably connecting the second power unit to the power unit transmission; and

a second torque coupling for selectively operably connecting the transmission to the power unit transmission.

25. A propulsion system as claimed in claim 24 wherein one of the plurality of transmission shafts is configured to connect the power unit transmission to at least one electrical generator.

26. A propulsion system as claimed in claim 24 or claim 25 further comprising at least one second energy conversion machine operable to drive the transmission; and

a power transfer arrangement for transferring power between the first and second energy conversion machines.

27. A propulsion system as claimed in any one of claims 24 to 26 wherein the at least one first energy conversion machine is a reversible hydraulic or electrical machine.

28. A propulsion system as claimed in claim 26 or claim 27 wherein the at least one second energy conversion machine is a reversible hydraulic or electrical machine.

29. A propulsion system as claimed in any one of claims 26 to 28 wherein the power transfer arrangement is hydraulic or electrical.

30. A propulsion system as claimed in any one of claims 24 to 29 wherein the first and second power units are operable to selectively drive the transmission and/or the at least one first energy conversion machine via the power unit transmission.

31. A propulsion system as claimed in any one of claims 24 to 30 comprising;

a first kinematic connection element mounted on one of the plurality of transmission shafts;

a second kinematic connection element interconnected with the first kinematic connection element and providing a rotatable input to the transmission.

32. A propulsion system as claimed in any one claims 24 to 31 wherein the transmission comprises at least one planetary gearbox.

33. A propulsion system as claimed in claim 32 wherein the at least one planetary gearbox comprises a sun gear, a plurality of planetary gears attached to a carrier and a rotatable ring gear.

34. A propulsion system as claimed in claim 33 wherein the sun gear is rotatably connected to the at least one second energy conversion machine, the ring gear is rotatably connected to provide the power output and the carrier is operably connected to the power unit transmission.

35. A propulsion system as claimed in claim 31 and claim 34 wherein the carrier is rotatably connected to the second kinematic connection element.

36. A propulsion system as claimed in claim 34 or claim 35 wherein the power output is provided by a rotatable transmission output shaft and the ring gear is rotatably connected to the transmission output shaft.

37. A work machine comprising the propulsion system of any one of claims 24 to 36.

38. A marine vessel comprising at least one propulsion system of any one of claims 24 to 36.

output to a single propeller. Furthermore it does not disclose how the speed of the propeller is controlled. This prior art system also does not provide means for the engines to supply power to the generators whilst both the engines and motors supply power to the propellers. Therefore, the battery may run out of energy to drive the motors. The system also does not provide flexibility in the propeller speed when the engine is run at full operational speed. Furthermore, no means are provided for increasing the propeller speed beyond the speed at which the motor and engines are providing maximum power to the propellers.

Summary

The present disclosure provides a propulsion system for providing a power output, the transmission comprising at least one planetary gearbox; said propulsion system comprising; a transmission configured to provide the power output; at least one first energy conversion machine; at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine; at least one second energy conversion machine operable to selectively drive or be driven by the transmission; a power transfer arrangement for transferring power between the first and second energy conversion machines; and at least one coupling operable to selectively connect and disconnect the at least one power unit and the transmission such that the at least one power unit is operable to drive the at least one first energy conversion machine independently of the transmission.

The present disclosure further provides a method of operating a propulsion system, said propulsion system

comprising; a transmission configured to provide the power output, the transmission comprising at least one planetary gearbox; at least one first energy conversion machine; at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine; at least one second energy conversion machine operable to selectively drive or be driven by the transmission; a power transfer arrangement for transferring power between the first and second energy conversion machines; and at least one coupling operable to selectively connect and disconnect the at least one power unit and the transmission; said method comprising;

connecting the power unit to drive the transmission; or connecting the power unit to drive the at least one first energy conversion machine; or connecting the power unit to drive the transmission and the at least one first energy conversion machine.

Although not falling within the scope of the claims, the present disclosure further provides a marine vessel comprising a propulsion system for providing propulsion to the ship, said propulsion system comprising; a power unit providing a rotational output to a power unit output shaft; a first kinematic connection element attached to the power unit output shaft; and at least one planetary gearbox providing a rotational output to a transmission output shaft, said transmission output shaft being connected to a propulsion element; wherein the first kinematic connection element is operably connected to the at least one planetary gearbox. Although not falling within the scope of the claims, the present disclosure further provides a propulsion system comprising; first and second power units; a

transmission configured to transmit power to a transmission shaft; at least one first energy conversion machine; and a power unit transmission; wherein said power unit transmission comprises; a plurality of transmission shafts operably connecting the power unit transmission to the first and second power units, the transmission and the at least one first energy conversion machine; a first torque coupling for selectively operably connecting the second power unit to the power unit transmission; and a second torque coupling

CLAIMS:

1. A propulsion system for providing a power output; said propulsion system comprising;

a transmission configured to provide the power output, the transmission comprising at least one planetary gearbox;

at least one first energy conversion machine;

at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine;

at least one second energy conversion machine operable to selectively drive or be driven by the transmission;

a power transfer arrangement for transferring power between the first and second energy conversion machines; and

at least one coupling operable to selectively connect and disconnect the at least one power unit and the transmission such that the at least one power unit is operable to drive the at least one first energy conversion machine independently of the transmission.

2. A propulsion system as claimed in claim 1 wherein the at least one first and second energy conversion machines are reversible hydraulic or electrical machines.

3. A propulsion system as claimed in claim 2 wherein the power transfer arrangement is hydraulic or electrical.

4. A propulsion system as claimed in any one of the preceding claims wherein the at least one power unit is operable to selectively drive the transmission via at least one drive shaft, at least one transmission coupling and at least one kinematic connection element.

5. A propulsion system as claimed in any one of the preceding claims wherein the at least one power unit is operable to selectively drive the at least one first energy conversion machine via at least one drive shaft and at least one kinematic connection element.

6. A propulsion system as claimed in claim 4 and claim 5 wherein the kinematic connection elements are gears, and the propulsion system comprises;

first and third gears mounted on a power unit output shaft;

a second gear interconnected with the first gear and providing a rotatable input to the transmission;

a fourth gear mounted on a first machine shaft and interconnected with the third gear, said first machine shaft providing an input or output to/from the at least one first energy conversion machine.

7. A propulsion system as claimed in claim 1 wherein the at least one planetary gearbox comprises a sun gear, a plurality of planetary gears attached to a carrier and a rotatable ring gear.

8. A propulsion system as claimed in claim 7 wherein the sun gear is rotatably connected to the at least one second energy conversion machine, the ring gear is rotatably connected to provide the power output and the carrier is operably connected to the at least one power unit.

9. A propulsion system as claimed in claim 6 and claim 8 wherein the carrier is rotatably connected to the second gear.

10. A propulsion system as claimed in claim 8 or claim 9 wherein the power output is provided by a rotatable transmission output shaft and the ring gear is rotatably connected to the transmission output shaft.

11. A work machine comprising at least one propulsion system of any one of claims 1 to 10.

12. A marine vessel comprising at least one propulsion system of any one of claims 1 to 10.

13. A method of operating a propulsion system, said propulsion system comprising;

a transmission configured to provide the power output, the transmission comprising at least one planetary gearbox;

at least one first energy conversion machine;

at least one power unit operable to selectively drive the transmission and/or the at least one first energy conversion machine;

at least one second energy conversion machine operable to selectively drive or be driven by the transmission;

a power transfer arrangement for transferring power between the first and second energy conversion machines; and

at least one coupling operable to selectively connect and disconnect the at least one power unit and the transmission such that the at least one power unit is operable to drive the at least one first energy conversion machine independently of the transmission;

said method comprising;

connecting the at least one power unit to drive the transmission; or

connecting the at least one power unit to drive the at least one first energy conversion machine; or

connecting the at least one power unit to drive the transmission and the at least one first energy conversion machine.

14. A method as claimed in claim 13 comprising a first mode wherein power is transferred to the transmission via at least one shaft, at least one kinematic connection element and at least one transmission coupling.

15. A method as claimed in claim 13 or claim 14 comprising a second mode wherein power is transferred via at least one shaft and at least one kinematic connection element to the at least one first energy conversion machine, said power being transferred from the at least one first energy conversion machine to the transmission via the power transfer arrangement and the second energy conversion machine.

16. A method as claimed in claim 14 and claim 15 comprising a third mode wherein power is transferred simultaneously in the first mode and the second mode.

17. A method as claimed in claim 14 to claim 16 comprising a fourth mode wherein power is transferred to the transmission in the first mode whilst power is transferred from the transmission to the second energy conversion machine.