CLAIMS

1. Motor controller (100) for driving and controlling the electrical motor (51; 51-2) of a blood pump (50) for percutaneous insertion, the blood pump (50) comprising an electrical motor (51) for driving the blood pump (50), the electrical motor (51; 51-2) comprising at least three motor winding units (Lu, Lv, Lw), wherein each motor winding unit (Lu, Lv, Lw) is arranged and configured to be individually connected to a power supply (110) via separate phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2) connected to respective motor winding unit terminals (LuE1, LuE2; LvE1, LvE2; LwE1, LwE2),

the motor controller (100) comprising

corresponding phase supply line driving units (DH1, DH2, DH3; DL1, DL2, DL3) for each motor winding unit (Lu, Lv, Lw) which are respectively connectable through the corresponding phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2) with one of the motor winding units (Lu, Lv, Lw); ~~and~~

a control unit (120) configured to control the phase supply line driving units (DH1, DH2, DH3; DL1, DL2, DL3) to operate the electrical motor (51; 51-2); and

at least one of: respective phase current measuring units (Ru, Rv, Rw) for measuring an actual value of the electrical current (Iu, Iv, Iw) through the corresponding motor winding unit (Lu, Lv, Lw); a total current measuring unit (Rtotal) for measuring the actual value of the total electrical current (Itotal) through all motor winding units (Lu, Lv, Lw); and respective measuring units configured for measuring a respective induced counter electromagnetic force, CEMF, for motor winding units (Lu, Lv, Lw) not driven;

wherein the control unit (120) is configured to detect a fault in one of the motor winding units (Lu, Lv, Lw), and, in case of a detected faulty motor winding unit, to adjust driving parameters for the faulty motor winding unit and to further operate the electrical motor (51; 51-2) by all motor winding units,

wherein the faulty motor winding unit is defined by at least one of: an interruption in the wire of the motor winding unit or in the corresponding phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2) of the motor winding unit; a current leakage of the motor winding unit to a casing of the electrical motor (51); and a short circuit between wire turns of the motor winding unit, and

wherein the control unit (120) is further configured to detect the faulty motor winding unit based on at least one of: the respective actual electrical current (Iu, Iv, Iw) through the motor winding units (Lu, Lv, Lw) or a comparison of the actual electrical voltage of the motor winding units (Lu, Lv, Lw).

2. Motor controller (100) of claim 1,

wherein each of the phase supply line driving units (DH1, DH2, DH3; DL1, DL2, DL3) is implemented by two corresponding half bridge units configured to be switchable for a cooperative control of the electrical power supplied to the corresponding motor winding unit (Lu, Lv, Lw).

~~3. Motor controller (100) of claim 1 or 2, further comprising at least one of~~

~~respective phase current measuring units (Ru, Rv, Rw) for measuring an actual value of the electrical current (Iu, Iv, Iw) through the corresponding motor winding unit (Lu, Lv, Lw);~~

~~a total current measuring unit (Rtotal) for measuring the actual value of the total electrical current (Itotal) through all motor winding units (Lu, Lv, Lw); and~~

~~respective measuring units configured for measuring a respective induced counter electromagnetic force, CEMF, for motor winding units (Lu, Lv, Lw) not driven.~~

3~~4~~. Motor controller (100) of any one of the claims 1 and 2~~1-3~~, wherein the control unit (120) is configured to drive and control at least one of the rotational speed of the electrical motor (51; 51-2), the rotational direction of the electrical motor (51), and the torque produced by the electrical motor (51; 51-2).

~~5. Motor controller (100) of any one of the claims 1-4,~~

~~wherein the faulty motor winding unit is defined by at least one of: an interruption in the wire of the motor winding unit or in the corresponding phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2) of the motor winding unit; a current leakage of the motor winding unit to a casing of the electrical motor (51); and a short circuit between wire turns of the motor winding unit; and~~

~~wherein the control unit (120) is further configured to detect the faulty motor winding unit based on at least one of: the respective actual electrical current (Iu, Iv, Iw) through the motor winding units (Lu, Lv, Lw) or a comparison of the actual electrical voltage of the motor winding units (Lu, Lv, Lw).~~

4~~6~~. Blood pump system, comprising the motor controller (100) of any one of the claims 1-3~~5~~ and a blood pump (50) for percutaneous insertion comprising an electrical motor (51) for driving the blood pump (50), the electrical motor (51; 51-2) comprising at least three motor winding units (Lu, Lv, Lw), wherein each motor winding unit (Lu, Lv, Lw) is arranged and configured to be individually connected to a power supply (110) via separate phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2) connected to respective motor winding unit terminals (LuE1, LuE2; LvE1, LvE2; LwE1, LwE2).

5~~7~~. Blood pump system of claim 4~~6~~,

wherein the electrical motor (51; 51-2) is a permanent magnet excited synchronous motor.

6~~8~~. Blood pump system of claim 4~~6~~ or 5~~7~~,

wherein the electrical motor (51; 51-2) comprises three motor winding units (Lu, Lv, Lw), each motor winding unit (Lu, Lv, Lw) being connected to corresponding phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2).

7~~9~~. Blood pump system of one of the claims 4-6~~6-8~~, wherein the electrical motor (51, 51-2) is an integral component of the blood pump (50), which is configured for being completely inserted percutaneously into a patient's body so that when the blood pump (50) is inserted, the motor controller (100) for providing electrical power to and controlling the electrical motor (51; 51-2) is located outside the patient's body and a connection for power supply to and control of the operation of the electrical motor (51; 51-2) is to be passed through a catheter (10) to the blood pump (50).

8~~10~~. Control method for controlling the power supply to motor winding units (Lu, Lv, Lw) of a blood pump (50) for percutaneous insertion comprising an electrical motor (51) for driving the blood pump (50), the electrical motor (51; 51-2) comprising at least three motor winding units (Lu, Lv, Lw), wherein each motor winding unit (Lu, Lv, Lw) is arranged and configured to be individually connected to a power supply (110) via separate phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2) connected to respective motor winding unit terminals (LuE1, LuE2; LvE1, LvE2; LwE1, LwE2),

wherein the method comprises:

(i) detecting a fault in one of the motor winding units (Lu, Lv, Lw);

(ii) in case of a detected faulty motor winding unit, and adjusting driving parameters for the faulty motor winding unit and further operating the electrical motor (51; 51-2) by all motor winding units (Lu, Lv, Lw)~~.~~;

~~11. Control method of claim 10,~~ wherein detecting a fault in one of the motor winding units (Lu, Lv, Lw) comprises detecting at least one of:

(a) an interruption in the wire of the faulty motor winding unit or in the corresponding phase supply lines (Lu1, Lu2; Lv1, Lv2; Lw1, Lw2) of the faulty motor winding unit;

(b) a current leakage of the faulty motor winding unit to a casing of the electrical motor (51; 51-2); and

(c) a short circuit between wire turns of the faulty motor winding unit; ~~and~~

~~(d) a short circuit between the wires of two of the motor winding units (Lu, Lv, Lw).~~

~~12. Control method of claim 10 or 11,~~ wherein detecting a fault of one of the motor winding units (Lu, Lv, Lw) is based on at least one of:

~~(a)~~ the respective actual electrical current (Iu, Iv, Iw) through the motor winding units (Lu, Lv, Lw); and

~~(b)~~ a comparison of the actual electrical voltage drop at the motor winding units (Lu, Lv, Lw)~~; and~~

~~(c) a comparison of the actual electrical current (Iu, Iv, Iw) through the faulty motor winding unit~~.

9~~13~~. Control method of ~~any one of the~~ claim~~s~~ 8~~10-12~~, wherein the electrical motor (51, 51-2) is an integral component of the blood pump (50), which is configured for being completely inserted percutaneously into a patient's body so that when the blood pump (50) is inserted, the motor controller (100) for providing electrical power to and controlling the electrical motor (51; 51-2) is located outside the patient's body and a connection for power supply to and control of the operation of the electrical motor (51; 51-2) is to be passed through a catheter (10) to the blood pump (50).