

DUAL MOTOR PUMP FOR SUBSEA APPLICATIONField of the Invention

The present invention relates to a pump primarily for use
5 in subsea applications, particularly in the oil and gas industry.

Background of the Invention

Exploration for oil and gas reserves below the sea bed is
10 becoming more important as stocks of more accessible natural resources dwindle and it becomes necessary to explore deeper and more difficult areas. Extreme depths and longer distances require higher capacity pumping apparatus which must also be robust and able to withstand the high pressures prevalent under
15 the sea, and the difficult conditions encountered at significant depths of salt water. In recent years there has been a trend towards using larger pumps which require larger and stronger electrical motors but there is a limitation on how far this technology can be extended. In addition, any new
20 technology in this field must be extensively tested and must pass qualification regimes which are time consuming and thus result in delays in putting the technology into effect in the field. They also take up considerable personnel resources and are thus expensive.

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Summary of the Invention

According to the present invention there is provided apparatus comprising a pump having a pump drive shaft for operating the pump, a first motor connected via a first
30 flexible coupling to drive one end of the shaft and a second motor connected via a second flexible coupling to drive the opposite end of the shaft, and a variable speed drive connecting each of the first and second motors electrically to

drive to the pump drive shaft.

Preferably the variable speed drive is common to the first and the second motor. Electrical conductors for the motors can
5 be cited in an umbilical cord which can be common for both motors.

The flexible couplings are preferably adapted to allow axial thermal expansion without affecting the operation of the
10 pump.

The invention can provide a higher capacity pump unit using proven technology. This makes the pump more acceptable in the industry and more cost effective to implement because it
15 can be put into use without the delay and cost of undergoing complex regulatory qualification processes. In addition the reliability of the pump is likely to be higher compared to a revolutionary new pump because tried and tested components are used. It also has the advantage of that, if one motor should
20 fail, the other will still drive the pump albeit at reduced capacity.

Brief Description of Drawing

For a better understanding of the present invention, and
25 to show how the same may be carried into effect, reference will now be made to the accompanying drawing, in which:

Figure 1 is a schematic cross section of a pump according to the present invention.

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Detailed Description of Drawing

A pump 1 comprises a pump shaft 2 which drives impellers 3. Fluid to be pumped enters the impeller section 3 via inlet

17 and exits via outlet 18. The pump 1 is contained within a pump housing 4. The pump shaft 2 is mounted for axial rotation on bearing assemblies 5 and 6 located at opposed ends of the pump shaft 2.

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A first electric motor 7 drives a first motor shaft 27 which is connected to one end of the pump shaft 2 via a first subsea motor coupling 8. The coupling is flexible and protected by a seal 9. A second electric motor 10 drives a second motor shaft 28 which is connected to the other end of the pump shaft 2 by a second flexible coupling 11 protected by a seal 12. The flexible couplings 8, 11 transfer torque from the respective shafts to the pump shaft 2 but allow longitudinal movement to allow for thermal expansion. Suitable flexible couplings may be achieved in many known ways. One example is to use an outer collar connected to one shaft by lock rings and to the other shaft by gear teeth which allow an axial sliding movement.

20 The motors 7 and 10 each comprise a stator 31 and a rotor 32 attached to the respective shaft 27 and 28.

The electric motors 7 and 10 may be induction motors or permanent magnet motors. They are preferably liquid cooled by a barrier fluid moving in either a single circuit or a double circuit (canned). The a barrier fluid protects the motors both from the pumped process fluid and the hostile surrounding environment which will typically be high pressure sea water. The barrier fluid isolates the motors preventing intrusion of sea water and preventing contamination from the pumping fluid.

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It also provides lubrication for the motors and provides cooling by transporting heat away from the moving motor parts, e.g. the bearings. To achieve this the barrier fluid

circulates in a closed circuit around the moving parts of the motor and the bearings and then the barrier fluid itself is cooled as it passes through pipes 30 around which sea water can circulate. The barrier fluid then passes back around the moving motor parts again. The circulation of the barrier fluid is achieved using an internal circulation (impeller) pump. The barrier fluid also helps seal the dynamic seals in the motors and pump. These dynamic seals have one stationary part and one rotating part and the barrier fluid is kept at a pressure slightly higher than the pressure of the process fluid being pumped so that a small amount of leakage of barrier fluid occurs into the process fluid. This prevents damage to the motors or pump by ingress of process fluid. It requires a constant supply of barrier fluid to the pump which is usually supplied via an umbilical from the surface.

The barrier fluid may be circulated in a double circuit if the motor contains a stator canning. Although not shown, this is a mechanical sleeve between the stator and the rotor which allows a separate stator fluid to be used and isolates the stator from the barrier fluid. The magnetic flux passes through the stator canning but the stator fluid will not pass through. A typical double circuit solution is described in WO 2008/127119. It allows the motor-pump arrangement to be more environmentally friendly since it allows more flexibility in the choice of barrier fluid and a specific stator fluid can be chosen to provide more dielectric properties for the stator, i.e. provide insulation for the stator. The stator fluid will also be cooled in a separate cooling circuit. A separate stator fluid circuit also isolates the motor better since it prevents any contamination through the umbilical.

The shaft 27 of the first motor 7 rotates in the opposite

direction to the shaft 28 of the second motor 10.

Power is supplied to the first motor 7 by power conductor line 13 via electrical connector 14, and to the second motor 10
5 by power conductor line 15 via electrical connector 16. A common power supply (not shown) may be used to supply power to both motors 7 and 10 and the power cables are preferably contained in an umbilical.

10 A variable speed drive may be used to control and change the frequency of the power supply so as to manage the speed of the pump, i.e. the number of revolutions of the pump shaft per minute. The variable speed drive may be situated topside or subsea and may be separate for each motor or common.

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The first and second motor couplings 8 and 11 transfer torque from the respective motors to the pump shaft 2. Their flexibility is such as to allow axial expansion and contraction due to thermal changes and to accommodate different running
20 characteristics of the two motors.

Claims

1. Apparatus comprising:
a pump having a pump drive shaft for operating the pump, a
5 first motor connected via a first flexible coupling to drive
one end of the shaft and a second motor connected via a second
flexible coupling to drive the opposite end of the shaft; and
a variable speed drive connecting each of the first and
second motors electrically to drive the pump drive shaft.
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2. Apparatus according to claim 1 wherein the variable speed
drive is common to the first and the second motor.
3. Apparatus according to claim 1 or 2 wherein at least the
15 first motor comprises an induction motor.
4. Apparatus according to any one of the preceding claims
wherein the first and the second motors comprise induction
motors.
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5. Apparatus according to claim 1 or 2 wherein at least the
first motor comprises a permanent magnet motor.
6. Apparatus according to claim 5 wherein both the first and
25 second motors comprise a permanent magnet motor.
7. Apparatus according to any one of the preceding claims
wherein at least the first motor is liquid cooled.
- 30 8. Apparatus according to claim 7 wherein the motor is liquid
cooled by a barrier fluid moving in a single circuit.

9. Apparatus according to claim 7 wherein the motor comprises a stator canning comprising a mechanical sleeve and a stator barrier fluid.
- 5 10. Apparatus according to claim 9 wherein the motor barrier fluid moves in a double circuit.
11. Apparatus according to any one of the preceding claims wherein the flexible couplings are adapted to allow axial
10 expansion.